

THE EAST AFRICAN AGRICULTURAL JOURNAL

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ZANZIBAR

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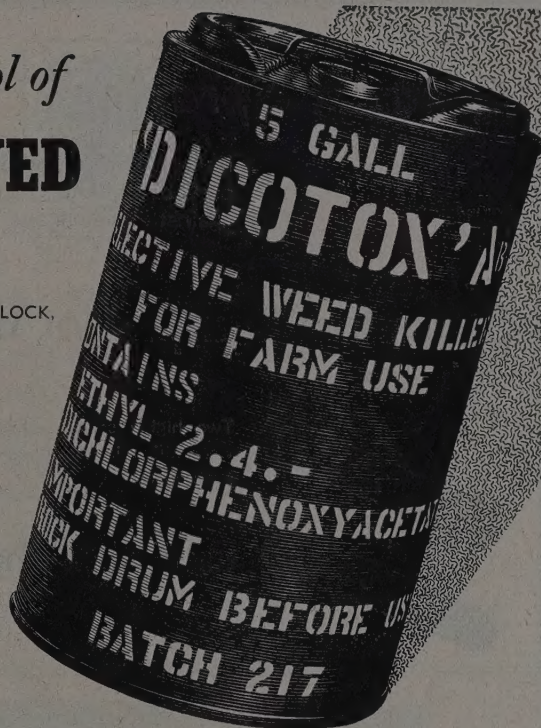
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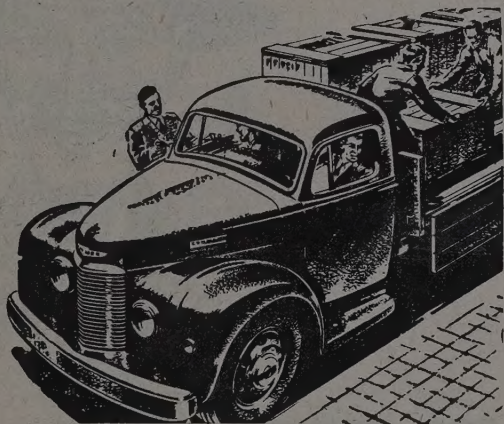
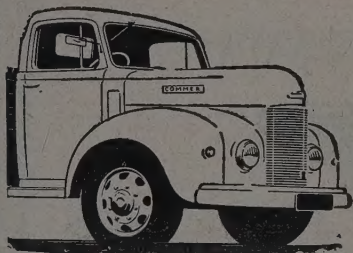
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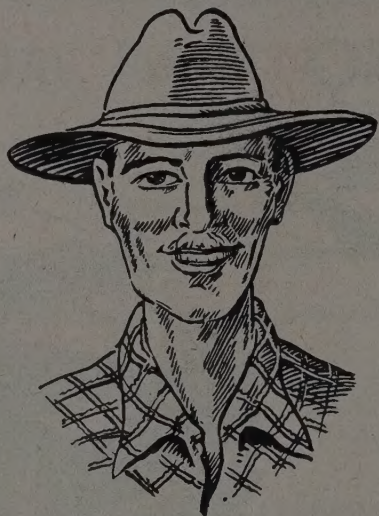
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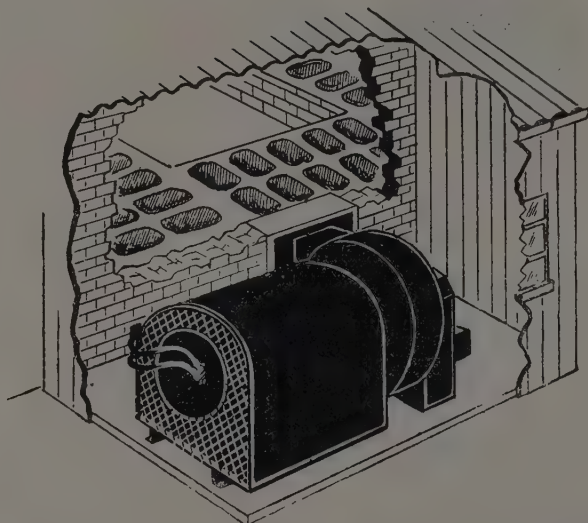
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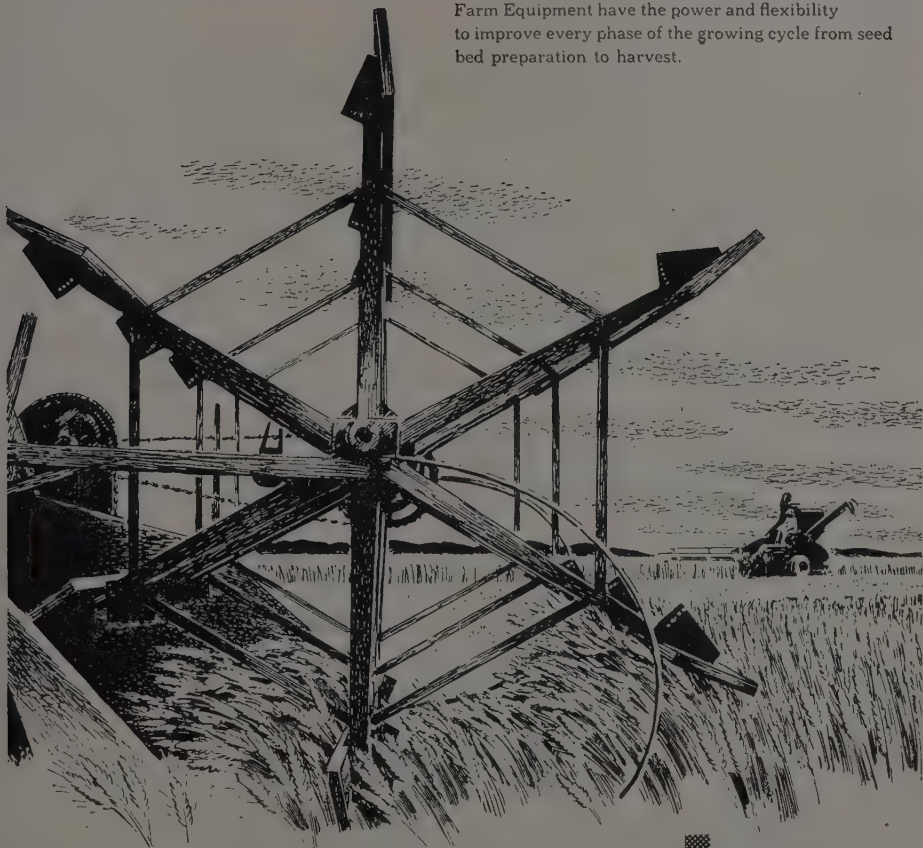


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Readers are reminded that all agricultural inquiries, whether they relate to articles in the Journal or not, should be addressed to the local Director of Agriculture, and not to the Editor.

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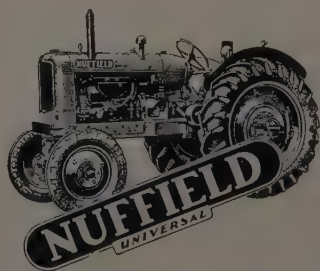
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ALICE IN WONDERLAND

The debate in the Central Assembly in September will have interested many readers of the *Journal*. In a vigorous attack on the expenditure for scientific research services a Member referred to the "Alice in Wonderland" atmosphere of the expanding research schemes. This led us into a most enjoyable excursion among nursery bookshelves, and into renewed appreciation of the satirical humour of Lewis Carroll's classics. Research workers in East Africa may perhaps take heart from their recollection that Alice was the only person able to maintain perspective in a very unusual world, and that her approach to the problem of her changing dimensions was definitely experimental. We are even tempted to pursue the simile, and to imagine the Red Queen shouting "Off with their votes" while the White Knight dealt valiant but random blows.

In more serious vein, however, this debate emphasized the need to explain continuously to the East African public just how the research services can serve and do serve the community.

To reply to the charges levelled at Alice, science found a redoubtable champion in Mr. E. A. Vasey, whose contribution to the debate, extracted from the Hansard record, is reprinted below.

Those engaged in research work realize how extensively the East African taxpayer does, in fact, get value for the money spent on these services, and how also, to some extent, does the more hard-pressed British taxpayer who shares so heavily in this particular financial burden.

It is therefore both the right and the duty of research staffs to keep the public informed, by articles prepared as far as possible in non-technical language, of the progress and practical implications of their work on local problems. First priority must naturally be given to the full technical presentation of the findings in the appropriate scientific publications, where the scrutiny and criticism of the scientific world operate most effectively. There is little enough time for the preparation of more popular expositions, but several recent debates in the legislatures have emphasized the need

for them. This *Journal* exists very largely to serve as a vehicle for such reports on agriculture, forestry and veterinary problems. The list of articles already published, which was surveyed editorially in our April issue this year, illustrates the substantial contribution already made to this essential liaison work. We therefore make a direct appeal to research workers in this group of problems for more frequent contributions of this nature.

Where problems are primarily of local significance the full data are often most appropriately reported in the *East African Agricultural Journal*, and many such papers have appeared in our pages. In these the accounts of experiments, observations and technical conclusions are usually given with admirable brevity, but they have not always been accompanied by appropriate discussion of the practical issues involved. We would therefore stress the importance of providing our non-technical readers with the clues which will help them to make practical use of the knowledge thus established.

Finally, to our readers, we make the request that they, too, should play their part in this diffusion of useful information, by drawing the attention of new readers to those articles which they find to be of particular value or interest.

H.C.P.

INVESTMENT IN RESEARCH

(Extract from *Proc. E.A. Central Legislative Assembly for 24th September, 1952*)

MR. E. A. VASEY:—

Sir, it is only on the question of research that I wish to speak and here I am afraid I must disagree with a large number of comments that have been made on the manner in which research should be judged and the basic motives of the expenditure on research. For, Sir, it is right—I speak from personal experience in this regard—that if you are a commercial firm large enough to indulge in your own research divisions and research organizations, as a commercial firm you would direct the activities of your research organization towards those subjects of research which are of

immediate and practical economic benefit. That is correct and that, of course, is the basis of a large number of research organizations of commercial firms, but those commercial organizations of commercial firms utilize a great deal of the results of the research work of organizations which have never been directed upon a commercial basis. If that comparative field of research results was not available to the commercial organizations and the commercial firms, they themselves would either see their research results paralysed or have to venture into that field of research which can only be carried out by public expenditure and public money. Who, Sir, is the real judge as to what is the eventual benefit to economy of the research that is now being carried out? Surely the whole story of disappointment, of failure after failure before success is achieved in any research field, is written in the history not only of this country but of the entire world. I suppose that some many years ago somebody referred to the experiment of Wilbur Wright in his attempt to take a machine into the air as the "dreams of Alice in Wonderland". I suppose exactly the same attitude was taken when Ross believed that he could do a great deal to alleviate and finally wipe out malaria. I suppose exactly the same attitude

was taken when Whittle first conceived his absurd but brilliant idea of the jet engine. But if we were to have applied to any of these things the immediate test of "what is the economic benefit", "what are the chances of result or failure", and "unless we can ensure success we will not let the experiment go forward", where would be the progress of to-day? So I cannot agree that we should judge the amount of research that must be undertaken by the test of what is the immediate economic benefit. In this scientific world, in this world where the economic progress of nations and the standard of living depends upon the result of that research, there must be men who can stand aside from the ordinary hurly-burly of economic life, from the need to produce immediate results that will satisfy clamouring taxpayers, there must be men who can be put aside from that, and investigate as to what progress and what development lie ahead. I have said, Sir, that these are personal views, but I would oppose as strongly as possible that we in this Assembly should make the mistake of believing that we should throttle our scientific research down at a time when it can contribute to the future development of this country—to things that we can never dream about. I would strongly oppose that we should apply to that the lay test of "is success certain?".

EAST AFRICA MILK RECORDING SCHEME

(Received for publication on 8th September, 1952)

During 1947, discussions took place regarding the revival of the Milk Recording Scheme, which had been forced to close down in 1939. In June, 1948, a meeting was held at Naivasha at which the Director of Veterinary Services, and representatives of all the East African Breed Societies were present.

At this meeting it was decided to launch the scheme on 1st January, 1949. The Veterinary Department undertook to carry out all the butter-fat testing at their laboratories at Kabete and the Director of Veterinary Services obtained a grant from the Kenya Government to assist in the financing of the scheme. It was also decided that in the early stages of the scheme, part time recorders should be employed in each district. These recorders were to visit each herd in their district once every two months to take samples for butter-fat testing.

From the very start the scheme received good support from dairy farmers all over Kenya, and there are now over 200 herds being officially recorded.

During his visit to Kenya in 1950, Mr. R. A. Pepperall, secretary of the Milk Marketing

Board, kindly attended a meeting of the Executive Committee, and gave much valuable advice and assistance. As a result of this meeting the Composite Testing Bucket, as used by the Milk Marketing Board, was introduced into the areas where entries were numerous. The introduction of this type of bucket has proved most successful.

By the middle of 1951, the problem which faced the committee was how to make known as widely as possible the lactation figures of cows which were entered in the scheme. Results are published each month in *Field, Farm and Garden* and members of each East African Breed Society receive regular lists showing the records of their own breed.

If suitable staff arrangements can be made, it is hoped in the future to make available for public information the records of unselected daughters of bulls, and other statistical information.

The records now published are arranged in age groups by breeds, showing the results of both pedigree and grade animals.

AYRSHIRE

Pedigree over two years, and under three at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
KILBIRNIE, 27th	Kivulini, Ltd., Molo	8,027.00	382.89	4.77	292
HEATHER 14 ..	Kivulini, Ltd., Molo	9,224.20	356.05	3.86	301
GENDIN ..	Gendin Farm, Nakuru	8,403.00	352.93	4.03	365
MILKYWAY ..	Juja Properties, Nyeri	7,764.80	347.09	4.47	353
AILIE 4th ..	Hafod Estates, Limuru	8,342.00	306.99	3.68	305

AYRSHIRE—GRADE

Over two years, and under three at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
LESIRKO 854 ..	Lesirko Ltd., Ol'Kalou	9,218.80	381.66	4.14	365
CARMEN ..	Cianda Estates, Ltd., Kiambu ..	7,739.00	355.22	4.59	334
STELLA ..	Hafod Estates, Ltd., Limuru ..	8,745.75	341.96	3.91	314
PEONE ..	E. M. & Mrs. Kidner, S. Kinangop	6,174.75	315.53	5.11	308

AYRSHIRE—PEDIGREE

Over three years, and under four at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
STEWART'S MAID	A. J. Stewart, Njoro	6,950.40	292.61	4.21	279
SCHIEHALLION					
BESS	D. Lyall, North Kinangop ..	7,388.00	291.83	3.95	270
BELLEVUE SNOW-DROP 2nd	Juja Properties, Nyeri	7,681.50	289.59	3.77	315

AYRSHIRE—GRADE

Over three years, and under four at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
VIOLA	E. M. & Mrs. Kidner, South Kinangop	8,423.60	365.58	4.34	289
LESIRKO 815	Lesirko Ltd., Ol'Kalou ..	7,626.20	315.72	4.14	365
NGUYU 1	E. M. & Mrs. Kidner, South Kinangop	7,231.20	301.54	4.17	315
BOUKJE VI	Kenya Tea Co. Ltd., Kericho..	8,053.00	277.02	3.44	356

AYRSHIRE—PEDIGREE

Over four years at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
MTARAKWA					
MAUDE 3rd ..	Mtarakwa Ltd., South Kinangop	12,319.00	497.69	4.04	305
KIVULINI PHYLI-DA 12th ..	Kivulini Ltd., Molo	10,140.10	455.29	4.49	242
EGLINTON MAINS					
VALERY ..	D. Lyall, North Kinangop ..	12,457.00	454.68	3.65	260
DRINMORE JANET	Col. A. F. W. Gossage, Naivasha	11,083.60	407.88	3.68	306
MTARAKWA					
NYMPH ..	Mtarakwa Ltd., South Kinangop	10,416.90	379.18	3.64	271

AYRSHIRE—GRADE

Over four years at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
HELEN	Hafod Estates, Limuru ..	11,231·50	426·80	3·80	365
BAA	Cianda Estates, Kiambu ..	10,983·50	408·59	3·72	335
KEN 1	Kivulini Ltd., Molo ..	8,583·20	393·97	4·59	333
MERURAI 454 ..	Deloraine Estate, Rongai ..	8,032·60	393·60	4·90	365
LABURNUM 1 ..	E. M. & Mrs. Kidner, South Kinangop ..	8,836·70	388·81	4·40	340
METENDEI 410 ..	Deloraine Estate, Rongai ..	9,167·70	381·38	4·16	336
NDEGE 4A ..	E. J. Radcliffe, Mau Summit ..	7,374·40	379·04	5·14	312

It is interesting to note that all these Ayrshire records are for Kenya breed animals, with the exception of Eglinton Mains Valery, who was imported from Scotland.

GUERNSEY

Pedigree over two years, and under three at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
TIP'S MARLENE OF FLEMISH FARM ..	Rhodora Estates, Nakuru ..	10,579·40	461·26	4·36	365
OLBONATA NELL	Olbonata Ltd., Nakuru ..	8,069·80	353·46	4·38	319½
WARE FLEURETTE 5th	Blundell Estate, Nakuru ..	7,855·90	351·16	4·47	365
HAWKHURST DULCIE 12th	M. S. Ray, North Kinangop ..	7,151·50	344·70	4·82	317½
MALVERLEYS PANSY 8th ..	Rhodora Estates, Nakuru ..	7,180·50	323·12	4·50	289

GUERNSEY—PEDIGREE

Over three years, and under four at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
MAYVALE REWARD'S MAR-GUERITE ..	Lt. Col. N. F. E. Chaplin ..	5,823·75	345·93	5·94	346

GUERNSEY—GRADE

Over three years, and under four at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		lb.	lb.	per cent	
RERI	S. S. Bastard, P.O. Sotik ..	7,529.10	344.83	4.58	286
VERONICA ..	R. H. Walker, Muhoroni ..	6,625.20	311.38	4.70	273

GUERNSEY—PEDIGREE—MATURE

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		lb.	lb.	per cent	
CHERKLEY REGENT'S ISOBELLA ..	Olbonata Ltd., Nakuru ..	10,015.90	452.72	4.52	365
WATERFALL BRACT ..	Olbonata Ltd., Nakuru ..	9,160.10	446.10	4.87	333½
OLBONATA HONEYSUCKLE	Olbonata Ltd., Nakuru ..	8,060.50	378.84	4.70	292½

GUERNSEY—GRADE—MATURE

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		lb.	lb.	per cent	
ANABKOI ..	Olbonata Ltd., Nakuru ..	8,420.10	446.27	5.30	361½
CHEPTENDEN ..	Blundell Estate, Nakuru ..	10,868.50	445.61	4.10	365
0-264	Ondiri Farm, Kikuyu ..	8,781.00	433.78	4.94	328½
MENEVAL ..	Rhodora Estates, Nakuru ..	9,464.70	407.93	4.31	341
0-240	Ondiri Farm, Kikuyu ..	9,527.00	381.08	4.00	361½
ROSE 1st ..	Agriculture Dept., Kitale ..	8,092.50	373.87	4.62	320
MENENGAI ..	Blundell Estate, Nakuru ..	8,813.60	363.12	4.12	365
WASCONG 131 ..	Rhodora Estates, Nakuru ..	8,013.00	360.59	4.50	315

JERSEY

Pedigree under 2½ years at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		lb.	lb.	per cent	
SOYSAMBU MAR- GHERITA ..	Delamere Estates, Soysambu, Elmenteita ..	7,082.50	315.17	4.45	269
CRYSTAL'S KATH- LEEN SOUTH- ERNWOOD ..	Dearlove & Jowitt, Ainabkoi ..	4,916.50	300.40	6.11	275

JERSEY GRADE
Under 2½ years at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
KAMBALA IV ..	D. E. Fielden, Nakuru ..	6,167.50	323.18	5.24	365
TREFOIL MAHARAJAH'S MARION 2 ..	R. A. Clay, Elburgon ..	5,208.25	311.45	5.98	271½

JERSEY PEDIGREE
Over 2½ and under 3½ at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
LANKHURST MARCELLA 2	R. A. Clay, Elburgon ..	9,447.00	540.37	5.72	365
ORIGA'S APRIL FLOWER ..	R. A. Clay, Elburgon ..	7,173.75	381.64	5.32	240½
TREFOIL STELLA'S MIGNONETTE	R. A. Clay, Elburgon ..	6,265.75	357.77	5.71	317½
SUNSHINE DESIGNED ..	A. W. Symes, Kitale ..	6,940.00	349.78	5.04	365
LANKHURST WINKLE 2nd..	R. A. Clay, Elburgon ..	7,606.25	344.56	4.53	267½

JERSEY GRADE
Over 2½ and under 3½ at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
TREFOIL FURIOUS MARGARET ..	R. A. Clay, Elburgon ..	9,214.50	476.39	5.17	340½
TREFOIL MAHARAJAH'S PRUDENCE ..	R. A. Clay, Elburgon ..	8,781.00	415.34	4.73	274
KABAI III ..	D. E. Fielden, Nakuru ..	8,199.75	405.89	4.95	296
SAMATIA IV ..	D. E. Fielden, Nakuru ..	8,477.10	394.19	4.65	330½

PEDIGREE—MATURE

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
OSIRUA LUNA ..	R. A. Clay, Elburgon ..	13,231.25	736.98	5.57	359½
OSIRUA HAPPY PRINCESS ..	R. A. Clay, Elburgon ..	11,628.75	640.74	5.51	365
OHLSSEN EDNA ..	Dearlove & Jowitt, Ainabkoi	8,064.50	509.68	6.32	365
ASTER'S EVER-GOOD LADY ..	V. Ellvers, Elburgon ..	7,824.00	450.66	5.76	376½
DREAM DAISY OF THE POPLARS	Delamere Estates, Soysambu, Elmenteita ..	8,697.00	427.89	4.92	276½
AVONLEA PINNACLE ..	Nderit Estate, Elmenteita ..	7,198.50	408.87	5.68	305
GRASS VALE LADY FOWLER 48th ..	Roderick Lea, Ltd., Limuru ..	7,971.25	407.33	5.11	354½
MOIBEN DEW-DROP 2nd ..	Watts-Williams, Nakuru ..	7,652.10	393.32	5.14	305

GRADE—MATURE

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
TREFOIL FURIOUS BELINDA ..	R. A. Clay, Elburgon ..	16,825.00	864.81	5.14	365
TREFOIL SETTLERS MARIA 2nd ..	R. A. Clay, Elburgon ..	8,519.50	442.16	5.19	297
RUBENI IV	D. E. Fielden, Nakuru ..	11,220.10	601.50	5.36	350
CHEPTOIGON 2nd	"	9,509.70	526.84	5.54	365
MARULA 3rd ..	"	7,500.50	500.28	6.67	365
BARAKOI IV ..	"	8,285.00	474.73	5.73	353½
TALITA 2nd ..	"	7,587.50	444.63	5.86	365
NDEBESS 2nd ..	"	7,371.75	444.52	6.03	343
RONGAI 2nd ..	"	8,209.20	439.19	5.35	282
THIKIRA 3rd ..	"	7,758.30	429.03	5.53	310½
BAMBA IV ..	"	7,813.90	413.36	5.29	345½
STIMA 2nd ..	"	7,722.00	413.13	5.35	356½
MKUBE 2nd ..	"	8,524.90	409.20	4.80	303½
YUPI IV ..	"	7,835.40	408.22	5.21	365
DESSIE 1st ..	"	8,078.50	406.35	5.03	298½
KAROI 3rd ..	"	6,315.00	389.78	5.44	350½
BELGAT ..	E. Combes, Nakuru ..	8,425.40	411.16	4.88	351½

The cow Furious Belinda holds the Butter-fat record over all breeds in Kenya, and Osirua Luna stands second to her.

FRIESLAND

Pedigree under three years at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
GLENSTUART AILSA ..	B. R. McKenzie, Nakuru ..	16,579.60	596.87	3.60	365
TUSOGO PRIM ..	" ..	14,328.20	524.41	3.66	349
KARIRANA TATTLE ..	" ..	11,858.10	447.86	3.76	303
KARIRANA TITTLE ..	" ..	11,765.00	437.66	3.72	365

FRIESLAND—PEDIGREE

Over three years and under four at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
EASTLEACH LOUISE 5th ..	B. R. McKenzie, Nakuru ..	12,452.30	452.02	3.63	301
KARIRANA DIVAN ..	" ..	12,439.40	439.11	3.53	316

FRIESLAND—GRADE

Over three years and under four at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
BLACKIE ..	W. Prentice, Nakuru ..	7,859.20	320.66	4.08	305
A.104 ..	Delamere Estates, Manera, Nai- vasha ..	8,720.50	319.17	3.66	365
DAIRYMAID 1 ..	C. N. L. Fernandes, Mweiga ..	9,312.50	316.63	3.40	322

FRIESLAND—PEDIGREE

Over four years and under five at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
TUSOGO MIRAN- DA ..	B. R. McKenzie, Nakuru ..	9,174.20	333.94	3.64	346
NDERIT FIGHTER'S GUAVA ..	" ..	8,888.90	305.78	3.44	320

FRIESLAND—GRADE
Over four years and under five at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
MILKFLOW ..	Belvedere Dairy, Kikuyu ..	11,755.30	461.98	3.93	360
MORENDAT ..	Smethcote Farm, Menengai ..	10,338.25	349.43	3.38	303
V.805 ..	Delamere Estates, Manera, Nai-vasha ..	9,998.00	337.93	3.38	365
JAY ..	Belvedere Dairy, Kikuyu ..	8,534.60	326.88	3.83	343

FRIESLAND—PEDIGREE
Five years and over at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
KARIRANA PUZZLE ..	B. R. McKenzie, Nakuru ..	21,633.50	646.84	2.99	365
KARIRANA JULIANA ..	"	17,929.90	598.86	3.34	348
MOUNTAIN FAIRY ..	"	17,038.20	582.71	3.42	365
KARIRANA POLY-ANTHUS ..	"	16,913.90	567.92	3.46	353
KARIRANA GEN-ESTA ..	"	14,843.30	521.00	3.51	328
KARIRANA SE-QUENCE ..	"	14,006.80	515.45	3.68	315
TULUET JOYCE ..	Barclay Estates, Menengai ..	15,036.00	485.66	3.23	360

FRIESLAND—GRADE
Over five years at calving

	Name of Owner	Milk	Butterfat	Butterfat	Days in Milk
		<i>lb.</i>	<i>lb.</i>	<i>per cent</i>	
VIOLET ..	Tatton Farm, Njoro ..	10,771.40	437.32	4.06	302
KIBURU ..	J. W. Etherington, South Kinan-gop ..	9,803.60	418.61	4.27	365
792 ..	Delamere Estates, Manera, Nai-vasha ..	12,820.00	416.65	3.25	347
MERERONI ..	J. W. Etherington, South Kinan-gop ..	11,433.30	412.74	3.61	365
X.563 ..	Delamere Estates, Manera, Nai-vasha ..	13,129.00	409.62	3.12	364
X.590 ..	"	11,701.00	401.35	3.43	365

The heifer record over all breeds for Butter-fat is held by Glenstuart Ailsa, who was imported from New Zealand.

Karirana Puzzle, who is countrybred, is the first pedigree cow to have given over 2,000 gallons in 365 days, since the Milk Recording Scheme started.

THE SIMONTORP RUBBER COWSHED

By Ruben Rausing, Blentarp, Sweden

(Received for publication on 31st July, 1952)

The attempts that I describe here have been aimed at solving a limited technical and economic problem in agriculture, and have been based on what I would like to call the methods of industry. What does that mean? It means examining the problem without reference to what has been previously achieved, endeavouring to formulate the aims I wish to attain, allowing the imagination to play freely over the entire field in order to arrive at a working hypothesis, and then to strive, to feel one's way forward and to reject the most part.

To determine the desired goal was not so difficult. A cowshed is a foodstuff factory for the production of perhaps our most important food; and it is only reasonable that its requirements should be equally exacting in various respects. One side of the business was naturally hygiene. The other was to try to bring about labour-saving methods which should embrace the actual work in the cowshed, and to establish a satisfactory manure economy. These different questions cannot be separated from each other, but must be included in the work as a whole.

We already possessed an up-to-date cowshed with automatic manure removal but it did not fulfil requirements. The cows were lined up on straw. This involved the transporting home, the cutting and the spreading of the straw. The cows could not easily be kept clean, as straw always absorbs manure. Thus the milk hygiene could not always be made absolutely first class and, finally, the transportation of manure from the cowshed, which had to be effected twice daily, was laborious from a work point of view. Considerable losses arose owing to storage in compost on the field. Loading of this manure for spreading, even with technical equipment, required considerable time; and the actual spreading was expensive and in practice involved large losses of nitrogen.

It therefore appeared to me that it was the straw that constituted the key to the problem. A strawless cowshed seemed to be the prerequisite for a reasonable solution. It was not surprising that I, like many others, first thought of rubber or plastic surfacing, and when I heard that experiments were being made in Holland in this direction, I decided to go there and have a look. The experiments I witnessed in Holland seemed to show that cows could stand on rubber, but no final solution of the problem had been reached.

In order to obtain the greatest possible advantages from a rubber cowshed the rubber surfacing over the entire cowshed must be absolutely free of cracks, in which manure can collect, so that the shed can, if necessary, be completely sterilized. In my opinion, the Trelleborg Gummifabrik have, by producing the existing surfacing, provided an excellent solution to the problem. The rubber has been vulcanized on sheet metal which is then fixed down by screws to iron set in concrete. The rubber strips have then been vulcanized together. There are no seams of any kind. Before building this cowshed we also carried out experiments for two years in an endeavour to find out the most suitable profiles for the rubber. For air must circulate beneath the cow when lying on the rubber.

An electrically charged wire hangs over each cow, about $1\frac{1}{2}$ inches over the withers. When the cow wants to dung or urinate she likes going forwards and at the same time arching her back. She then receives a slight electric shock on touching the wire, retreats backwards and the manure falls into the manure channel. Manure in the stalls is seldom to be seen.

Now that the straw was out of the way, there was no reason to separate urine and solid manure. In the manure channel, which is also of rubber, the manure is handled by tight-fitting rubber scrapers and swept down into an underground concrete basin, holding about 1,200 cubic yards. All the flushing water is also automatically carried down into the basin, and the thick mash is carefully mixed by being pumped round. To prevent access to air a thin layer of old tractor oil lies over the entire surface; this need never be renewed. As no noticeable formation of gas occurs, it seems probable that losses are negligible in this liquid manure storage. This manure is spread in two ways. On the one hand it is pumped into tankcars containing $3\frac{1}{2}$ cubic yards. Behind this tankcar drawn by tractor follows an earthing equipment with plate-discs of our own construction, which earths the manure as soon as it reaches the ground, even in crops sown in rows, as, for instance, beets or potatoes. On the other hand, manure on grazing land is spread with the irrigation system. From the manure basin a pipe leads piping for water and the liquid manure is pumped into the irrigation system. The amount added to the

water is constantly under control. The surplus amount is returned to the basin.

In the course of this autumn attempts will be made, on the one hand, to spread the manure directly on to the straw left after the combined threshing, and, on the other, to collect the straw, continually pump manure on to it, and in this manner bring about a compost in the field itself.

The construction of the shed will be briefly dealt with. It is entirely constructed of pre-fabricated siporex blocks. The roof consists of siporex blocks plus siporex slabs with ventilation ducts and over this double layers of maintenance-free roofing. Thus the roof is ventilated under the roofing material. The walls are especially simple and completely maintenance-free. There is no window in the walls. In the roof are three lanterns of varied construction and the whole is supported by an iron framework. The overhead lighting is thus evenly distributed and the cowshed is very well lighted and pleasant. Air intake is arranged partly through vents and partly by means of a fan; out-take is through air ducts. The cowshed has room for 120 tied animals and, in addition there are 22 loose-boxes, office, laboratory, washing, milk and sterilizing rooms, packing room, fodder section, etc.

In the immediate vicinity of the cowshed are five large tower silos, measuring 16 ft. by 52 ft. and together holding 1,640 cubic yards; there is also a grain silo with a drier. Both end in a fodder room with fodder mixers, fodder bunkers and hammer mill. Fresh fodder is distributed by large stainless steel cars suspended from the roof and drawn by an electric engine. The speed is so adapted that the operator need only walk behind the car and rake down the fodder. Concentrates are distributed individually to each cow in metal containers, which are transported hanging on a vertical fodder car of simple construction.

What do I gain by these expensive plants? All transportation and handling of straw, all litter and its raking, disappear. Unloading into compost and loading from compost completely disappear. With the pump four tons of liquid manure is loaded in $2\frac{1}{2}$ minutes. The cows become cleaner and much of the grooming can be dispensed with. A condition for satisfactory milk from a hygienic viewpoint is healthy udders in the animals. Rubber surfacing offers possibilities in this respect which cannot otherwise be had, provided the animals are well looked after. The investigations carried out by A. Johannsen, the Lund city veterinary surgeon, in the course of this winter with samples from

each quarter of each cow have revealed what all consider to be very good results. When these experiments have been finally completed, a full report will be submitted to another tribunal.

From the well-cleaned udder from which the first milk is taken by hand in a sampling vessel before applying the machine the milk goes into a pail of special construction with a double lid to prevent any air coming into contact with the milk. These pails are transported on cars to the milkroom, from which the milk is sucked without any contact with filter equipment that could pollute the milk, directly into the refrigerating machine, and from there into sterilized, stainless steel tanks. The milk pails are carefully cleaned and sterilized in steam sterilizing boxes before being used. From the steel containers the milk can be sucked direct on to a Tetra Pak packing machine where it is packaged in sterilized paper and hermetically sealed by fusing the plastic seam.

It may then be asked whether such large capital investments can be profitable in Swedish agriculture. The answer to this cannot of course be given to-day as there are so many uncertain factors in the situation. We do not know what period of depreciation we must calculate on where rubber is concerned. The plant is not yet entirely equipped so that we do not yet know what economies in labour we shall finally be able to make, and the question of manure economy is not yet possible to gauge. Agricultural wages in cowsheds are as far as I know the highest wages paid to any group in Sweden; and investments that succeed in economizing in labour should show handsome returns in this field. Work in cowsheds has also been always considered dull and dirty. A cowshed in which none need handle manure and its distribution must be pleasanter to work in.

Note.—Inquiry from the author has elicited the following information, which will be of interest to practising farmers. In the dairy system described above, the cattle are Swedish Red; the butter-fat yield from about 120 cows this year averages 440 lb. per head, with an average fat percentage of 4.3.

The "Siporex" blocks are of steam-cured light-weight concrete, a highly porous material, remarkably light in weight (30 to 40 lb. per cubic foot, according to requirements) with a corresponding minimum compressive strength of 425 to 710 lb. per square inch and very good heat-insulation. [Editor.]



Detail of Rubber Flooring



Earthing Attachment for Manure Tank Car

THE HYDROCYANIC ACID CONTENT OF PERENNIAL KAVIRONDO SORGHUM

By D. P. Braithwaite, Veterinary Research Laboratory, Kenya

(Received for publication on 10th October, 1952)

A study has been made of the hydrocyanic acid content of perennial Kavirondo sorghum (strain R.2S42) at various stages of growth. A maximum value of 0.085 per cent was recorded for young growth under dry conditions.

The present investigation was commenced in 1950 after a number of deaths from cyanide poisoning had occurred in cattle allowed to graze on sorghum. The existence of cyanogenic glucosides in sorghum has long been recognized but it was felt desirable to investigate the improved R.2S42 strain of perennial Kavirondo sorghum (Edwards, 1941).

Dowell (1919) found that sorghum cut after a drought contained 0.0514 per cent HCN whereas that grown under normal conditions contained only 0.022 per cent. Acharya (1933) states that the cyanide content of cholam in the early stages of growth is high but declines steadily to a minimum at the flowering stage, and that high values occur in droughted plants and secondary growths.

MATERIALS AND METHODS

The hydrocyanic acid (HCN) in sorghum is present almost entirely as combined glucoside, and is only liberated when the glucoside and its specific hydrolytic enzyme are brought into contact by breakdown of the plant tissue. The hydrolysis can also be accomplished by chemical methods but the enzyme is a more rapid and satisfactory agent in that it does not bring about any other change in the plant material which might interfere with the analysis.

HCN is a gas and therefore easily lost by vaporization. It undergoes slow decomposition in aqueous solution. Thus, if the plant material is finely minced to give intimate contact of enzyme and glucoside, and hence rapid liberation of HCN, there is a danger of loss by volatilization; if, however, the material is only coarsely chopped and left to soak in water in a closed vessel for several days, there is a loss of cyanide by decomposition. Van der Walt

(1944) overcame the latter difficulty by adding a small quantity of mercuric chloride to the suspension to "fix" the cyanide as the relatively unionized (and therefore stable) mercuric cyanide; attempts to use this method in the present investigation were unsuccessful. The liberation of cyanide was very slow due to the inactivation of the enzyme (in one case it was incomplete after 14 days) so that a large number of flasks would be necessary for storage of samples. Moreover, with young sorghum, large quantities of volatile organic-reducing substances were produced on prolonged standing in water and this seriously interfered with the estimation. It was therefore decided to accept the possibility of slight loss of HCN whilst mincing the samples.

The method finally adopted for the preparation of samples was as follows: Three or four plants were cut to about inch lengths and a portion (100 gm. for low HCN content material, proportionately less for higher contents) quickly weighed, minced and washed with water into a 1,000-ml. flask which was then stoppered. The flask and contents were placed in an incubator at 35° C. for two hours.

The HCN was then isolated by aspirating a stream of air (freed from carbon dioxide) through the flask placed on a boiling water bath; the vapour was cooled by passage through a condenser and the HCN absorbed in two 50-ml. traps in series each containing 10 ml. N/10 sodium hydroxide. After two hours, fresh adsorbent was placed in the traps, and aspiration continued for a further half hour to determine whether removal of cyanide was complete; if not, it was continued for further half-hour periods.

The cyanide in the distillate was determined by the alkaline titration method with N/50 silver nitrate (A.O.A.C., 1950).

RESULTS

Preliminary experiments had suggested that the aftermath (secondary growth) was more poisonous than the original crop and attention

was therefore focused on this aspect of the problem. By arrangement with the Senior Pasture Research Officer, a one-acre plot at Kabete was sown with perennial Kavirondo sorghum (strain R.2S42) in March, 1950, before the long rains.

Results of the tests on the original material (plot A) are shown in Table I. They indicate a progressive fall in HCN content as the crop matures followed by a slight rise during seeding which, however, is accompanied by a marked rise in the dry matter; all the figures are comparatively low and on a dry-weight basis there is no significant increase.

TABLE I
HCN CONTENT OF ORIGINAL GROWTH—
PLOT A

Date	HCN mgm./ 100 gm. Wet	Dry Matter	HCN mgm./ 100 gm. Dry
		<i>per cent</i>	
12-4-50 ..	19	11	173
19-4-50 ..	14	10.5	133
27-4-50 ..	9	12	75
4-5-50 ..	6	13	46
11-5-50 ..	9	11.5	78
18-5-50 ..	6	10.5	57
26-5-50 ..	7	14	50
1-6-50 ..	5	15	33
8-6-50 ..	7	17.5	40
15-6-50 ..	9	19	47
22-6-50 ..	11	23	48
31-7-50 ..	10	30	30
26-8-50 ..	11	—	—

AFTERMATH

Secondary growth occurs readily in sorghum (even in dry conditions) when the original stem is severed so in addition to studying the change in cyanide content of aftermath with increasing age of that growth, it was also possible to determine the effect of season by varying the date at which the original growth was cut (i.e. the date at which re-growth commenced). Starting on 1st June, when the crop was in flower and conditions were still moist, four complete adjoining rows of the sorghum were cut just above ground level each week. By this means the original plot of sorghum was converted into a number of sub-plots of aftermath, each sub-plot being one week older than the next. Thus there was available aftermath

growth of varying age throughout the remainder of the dry season. (By having four rows in each sub-plot it was possible to take several samples without sampling any individual plant more than once.)

The results obtained are shown graphically in Fig. 1 in which the HCN content is plotted against the calendar date; points representing aftermath growth of the same age (i.e. at the time of sampling) are joined together. It will be seen that the general trend for each age-group is an increase in HCN content as the season advances; thus, for example, the aftermath which was four weeks old at the end of September (hot, dry conditions) has almost twice the HCN content of aftermath four weeks old at the end of June. Conversely, however, on any given date, the greater the age of the aftermath, the lower the HCN content. The HCN content of each sub-plot decreased with increasing age in the same manner as the original growth, though the initial values became greater as the season advanced. It was concluded from these results that the cyanide content of sorghum is related to initial growth, but more particularly to the dryness of condition at the time of growth.

It was intended to continue the experiment into the rainy season but unfortunately the whole crop was cut in the middle of October, 1950. The maximum value recorded was 85 mgm./100 gm. for three-week-old aftermath on 10th October, although a value of 91 mgm./100 gm. was recorded for the aftermath of a different strain ("mtama-like") growing on an experimental plot.

Signs of wilting in the aftermath were first noticed in the young growth on 26th September and was general by 2nd October. Monthly rainfall figures for Kabete are shown in Table III.

In order to determine the cyanide content of aftermath growing in normal conditions a further plot was sown in April, 1951. This was harvested in October of that year, the second crop (Aftermath I) cut in March, 1952, and at the time of writing (August, 1952), was in flower for the third time (Aftermath II). The results obtained from the plot are shown in Table II; it will be seen that both aftermath crops show the same trend as the original growth (cf. Table I), viz., an initial value of about 20 mgm./100 gm. followed by a steady fall to less than 10. This confirms the view

that very high cyanide contents are due to growth in dry contents and not merely to re-growth.

TABLE II

HCN CONTENT (MG./100 GM. WET)—PLOT B

ORIGINAL GROWTH		AFTERMATH I		AFTERMATH II	
Date	HCN	Date	HCN	Date	HCN
16-5-51	21	20-11-51	26	30-4-52	26
6-6-51	15	3-12-51	14	4-6-52	12
10-7-51	10	27-12-51	9	17-7-52	10
23-8-51	9	7-2-52	6	12-8-52	8
24-9-51	4				

TABLE III
RAINFALL (INCHES)

	1950	1951	1952
January	1.61	0.44	0.76
February	0.55	0.16	0.95
March	4.56	3.93	0.42
April	10.07	13.85	15.48
May	2.91	11.86	8.15
June	0.87	5.50	0.03
July	0.33	1.26	0.44
August	1.76	0.96	
September .. .	0.35	0.02	
October	2.90	4.09	
November .. .	3.10	5.69	
December .. .	0.55	8.75	
	29.56	56.53	

TOXICITY

It is generally agreed (e.g. Leeman, 1935) that the lethal dose of hydrocyanic acid for a ruminant is 1 mgm. per lb. bodyweight. On this basis the fatal dose of sorghum containing 0.020 per cent HCN (20 mgm. per 100 gm.) for a 400-lb. ox would be present in slightly less than $4\frac{1}{2}$ lb., and for a 50-lb. sheep in $\frac{1}{2}$ lb. These figures are sufficient to show that any sorghum is potentially a dangerous material. They are calculated, however, on the assumption that the sorghum is consumed in a short period of time and that the cyanide is immediately liberated from the glucoside; obviously, neither of these conditions is even approximately true, and since cyanide is fairly rapidly eliminated by the body, the quantity of sorghum which can be consumed without fatal consequences may well be two or three times larger than the figures given above.

Stall-fed animals consumed the mature sorghum (10 mgm. HCN 100 gm. or less) readily and with no ill effects, but could not be persuaded to take the young aftermath under any circumstances; it was not, therefore, possible to obtain any figures relating toxicity to actual cyanide content under conditions of normal consumption. At the conclusion of chemical tests on the first plot (a), three steers were confined on the plot for several days without ill effect; the sorghum contained about 35 mgm./100 gm. cyanide but the plot was by then overgrown with weeds and there was no evidence of any great consumption of sorghum by the animals.

To confirm the toxicity of aftermath sorghum, recourse was made to drenching sheep with the material minced with water as for the chemical estimation. Because of the time interval between mincing the sorghum and commencing drenching, liberation of the cyanide was sensibly complete. The samples were taken from three different age-groups which had been assayed during the previous two days, and the quantity of material used calculated from these figures for the particular sheep at the rate of 1 mgm. HCN per lb. body-weight.

(a) Row No. 22, age $5\frac{1}{2}$ weeks, 40 mgm./100 gm. HCN

(i) 110 gm. sorghum (= 44 mgm. HCN) given to sheep I, 43 lb. weight. Severely affected and died within one hour with typical symptoms of cyanide poisoning.

(ii) 125 gm. sorghum (= 50 mgm. HCN) given to sheep II, 50 lb. weight. Affected but recovered.

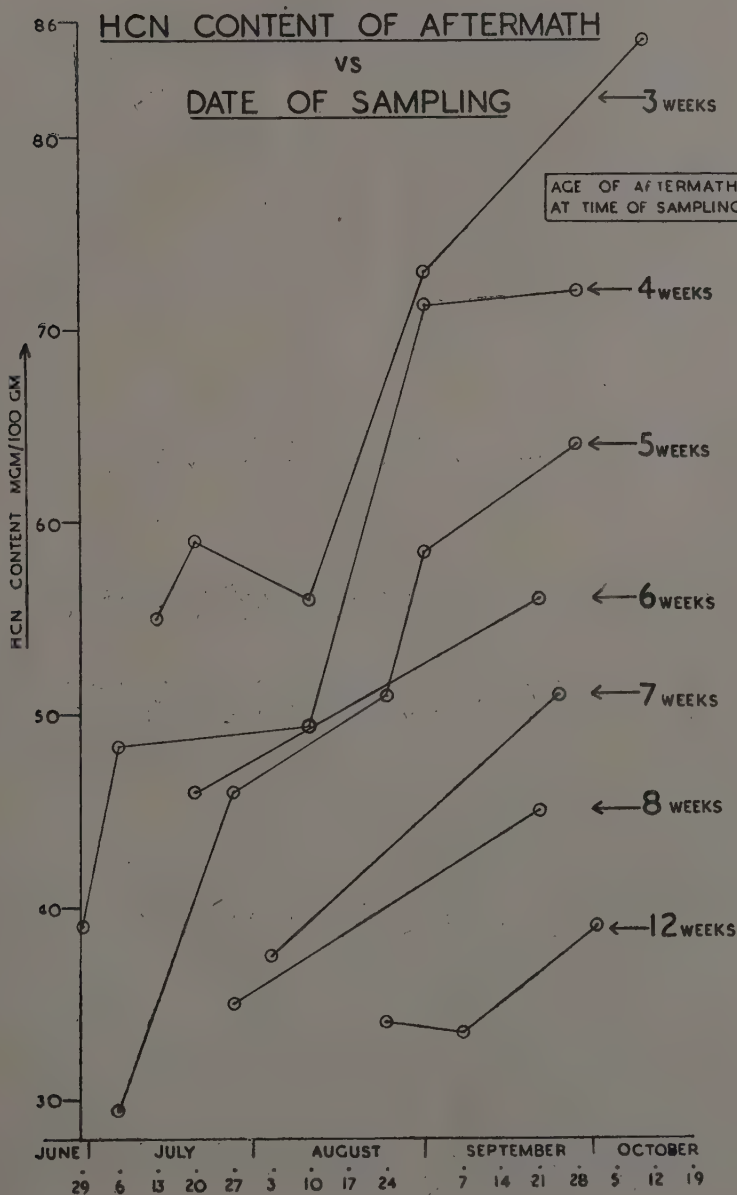
(b) Row 23, age $4\frac{1}{2}$ weeks, 42 mgm./100 gm. HCN

147 gm. sorghum (= 62 mgm. HCN) given to sheep III, 59 lb. weight. Severely affected, becoming unconscious at completion of drenching (see note).

(c) Row No. 27, age $3\frac{1}{2}$ weeks, 51 mgm./100 gm. HCN

100 gm. sorghum (= 51 mgm. HCN) given to sheep II, 50 lb. weight. Severely affected, unconscious at completion of drenching (see note).

(Note.—The sheep in (b) and (c) were both revived by an intravenous injection of sodium thiosulphate (10 ml. of 20 per cent solution) without which they would certainly have died.)

FIGURE I

CONCLUSIONS

1. The hydrocyanic acid content of perennial Kavirondo sorghum, strain R.2S42, has been shown to fall from 20-30 mgm./100 gm. for the young plant to about 10 mgm./100 gm. when mature. These figures are for normal conditions in which initial growth occurs from moist soil; subsequent dry conditions whilst the crop is maturing do not significantly affect the cyanide content. The mature sorghum is a perfectly safe feeding stuff, and even young growth under the stated conditions is unlikely to prove harmful.

2. When initial growth of sorghum aftermath was induced under dry soil conditions the cyanide content was considerably greater than in normal conditions. The increase is not a property of the aftermath *per se* and may therefore be presumed to occur also in growth

from seed under drought conditions. It is dangerous, particularly when wilting is apparent, to allow stock to graze such material.

3. Aftermath grown in normal conditions (i.e. rainy season at initial growth) contains no greater concentration of hydrocyanic acid than the original crop.

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A BRITISH STANDARD FOR COMMON NAMES FOR PEST CONTROL PRODUCTS

(B.S. 1831, Part I, 1952)

During the last 25 years great advances have been made in the development of chemicals for pest, weed and rodent control. In the past 10 years in particular, many new compounds have been marketed on a world-wide scale for use in agriculture, in industry, in medicine and in veterinary practice. The chemical names of these compounds have been, in many instances, too complicated for common use, and shortened forms and trade names have been devised. As several of these may apply to the same chemical compound, confusion has arisen in commercial descriptions of products and also in the technical literature.

In an endeavour to reduce this confusion, a British Standard list of coined common names has been issued for established pest control products, embracing insecticides, insect repellents, acaricides, nematocides, fungicides, herbicides and rodenticides. These names do not conflict with proprietary names, but are intended for common use to assist users in the identification of the active ingredients of pest

control products having otherwise cumbersome technical names. It is emphasized that these names are in no way proprietary, but in order to pre-empt as far as possible their availability as common names they have been recorded, though not registered as Trade Marks, by H.M. Patent Office.

Wherever possible, the names adopted are those already accepted as coined common names by the United States Inter-departmental Committee on Pest Control, and the same system of protection is given by the U.S. Patent Office. It is hoped that the same measures will extend to other countries in due course. During the drafting stages, the Technical Committee has maintained liaison with the Commonwealth countries as well as with the appropriate committee in the United States.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 24, Victoria Street, London, S.W.1., price 2s. 6d.

BEE-KEEPING OBSERVATIONS IN TANGANYIKA, 1951/52

By Francis G. Smith, Beeswax Officer, Department of Agriculture, Tanganyika

Yields from individual colonies of bees have been disappointing during the past bee-keeping year. The 1950/51 season left the bees strong and colonies plentiful; the current year has been excellent for bee breeding and great numbers of swarms occurred, resulting in an overall increase in the bee population of the territory. However, even those bee colonies which did not swarm have collected only small crops, though the total production for the territory is probably greater than last year, owing to the increase in the bee population.

The reasons for the small individual crop are attributed partly to very changeable weather during the September–December honey-flow period, and partly to the storms during April and May which destroyed much of the *Isoberlinia* blossom and in some cases destroyed hives as well, particularly in the cyclone area in Southern Province.

In some areas the native bee-keepers do not consider it worth collecting the crop; they are leaving it for the bees to build up on for the next season. In this one sees the dawning of true bee-keeping on the part of the African.

The scale hive at the Talikwa Out Apiaries near Tabora reflected the general condition fairly accurately. Starting the year on the 1st of August with a gross weight of 95 pounds, it remained steady until the first flowers in mid-August stimulated breeding. Gentle fluctuations occurred until mid-September when a short, light honey flow of nine days terminated in cold winds followed by hot, dry weather. From 98 lb. on 24th September, the weight declined to 85 lb. on 24th October. A short, sharp flow caused the hive to recover to 95 lb. but from the end of October until 20th December there was a gradual decline. The next week produced a light honey flow increasing the hive weight by 10 lb. From the end of December until 10th April there was a fluctuating decline of altogether 22 lb. The *Isoberlinia* flow commenced on 10th April and continued until 31st May giving an increase in weight of 63 lb. Between 10th and 26th May the curve was steepest, the largest increase recorded in any one day, 15th May, being 12 lb.

The prospects for the new season appear favourable. 1951/52 rains were heavier than normal and there is more surface water in the Miombo woodland than there has been since 1947. Bee colonies are plentiful. Will the new season be a bumper year like 1948? It all depends on the weather between now and the end of May next year: if climatic conditions are right for nectar secretion when the more important bee plants are flowering, then we may have a bumper year.

This brings us to a new subject for examination: climatic conditions. There are many problems involved. Why did the September–December flowering period fail to yield a crop this year? Why do the thousands of mango trees at Tabora fail to yield nectar with sufficient sucrose to attract the bees, while the mangoes of Kilosa, Nyonga and Songea apparently yield profusely? A start has been made to try and find the answer and a small meteorological station has been established at Talikwa. Daily rainfall and maximum and minimum temperatures are being recorded, together with atmospheric humidity taken four times daily; these recordings will be plotted with daily alteration in hive weight. That might show us the answer.

Up to now observations have been made only at Tabora. Another scale hive is being established at Songea and when equipment is available a station will be established in the Southern Highlands. Nothing is known about the possibilities of bee-farming in upland areas; after the grass has been burnt early in the dry season on the upland grasslands, a profusion of flowering herbs appears, many of them yielding nectar. Nothing is known about the cloud forest areas. They are small but they might be important.

Here in East and Central Africa we are at the beginning of learning about bees. We cannot draw on the experience of other bee-keeping countries because none of them has our climate or our vegetation. The major honey plants of temperate climates do not grow here, or grow only in very restricted areas. The plants from which the bee farmers in other parts of the world make their living such as

alfalfa (lucerne), the clovers, buckwheat, citrus, eucalyptus, heather, lime, sainfoin, tulip tree; tupelo and willow herb, are non-existent or very local in their distribution here. Instead we have *acacias*, *isoberlinia*, *brachystegia*, *combretum*, *terminalia*, *athrixia*, *blepharis*, *justicia*, *becium*, *cryptocephalum* and numerous other genera, whose nectar-yielding possibilities are unknown.

On the equipment side we have started to use some modified Dadant hives. The bees appear to work the 1½-in.-spaced frames perfectly, but it is too early to say anything more. We are bringing into use shallow supers, for both M.D. and Langstroth hives, having a depth of 6½ in. These supers take the Manley shallow frame, which is in the writer's opinion the ideal super frame. The Langstroth 6½-inch super takes nine of these frames, and ten go into the M.D. super. Having one size of super frame for both Langstroth and M.D. hives simplifies the supply problem as well as making the frames interchangeable. As metal runners are not considered necessary in supers, the rebates are cut only ⅜ in. deep.

A sharp lesson was learnt on the matter of wiring frames. The road journey with hives of bees from Tabora to Iringa showed that combs built on ready-wired foundation would not stand up to the jolting, as the combs simply slipped down the wires. If it is required to transport hives of bees and supers of honey then the frames themselves must be wired and the wires embedded into the foundation. With M.D. brood frames five horizontal wires should be used, two inches between each wire. In the case of Langstroth frames four wires should be enough, and in shallow super frames two wires should be fitted.

No bee diseases have yet been discovered though there are numerous pests. In addition to the honey badger, *Mellivora capensis sagulata*, Hollister, there are several unidentified bee-eating birds. In the hives themselves will be found small hive beetles, *Aethina tumida*. These tiny beetles always seem to be present but provided that the bees are strong, and they can get into the beetles' hiding places, the bees keep the beetles under control. This pest is one of the reasons why the fancy hives beloved of so many European bee-keepers are unsuitable here. A hive must be as simple as possible, affording no hiding place for pests. The large hive beetle, *Holoplostomus fuliginus*, is sometimes found in weak colonies

but these can be easily picked out by the bee-keeper and destroyed. The greater wax moth, *Grisella mellonella*, is an ever-present menace to unguarded combs, but strong colonies keep it under control, and will clean up combs infested with larvae of the moth. The small hive beetle and the wax moth make the storage of spare combs a problem and at present we are giving boxes containing combs to strong colonies for the bees to keep free of these pests. The death's head hawk moth, *Acherantia atropos*, has been encountered in hives in Tabora. However, the bees soon demolish these pests which come in probably to try to steal honey. The bee louse, *Braula pretoriensis* or *Braula kohli*, is sometimes seen on the queen, but it has not been found to be a serious pest. The latest pest to be observed at Tabora is the banded bee pirate, *Palarus latifrons*, which has been seen sitting on hives and swooping on passing bees. A boy armed with a small net has been found quite effective in dealing with this pest. A number of species of ants attack beehives but the smearing of banding grease round the legs of hive stands seems to be a satisfactory protection. Some bee-keepers burn wood round the foot of trees containing hives as they have found that the ash gives some protection against ants.

A study has been made of the larger stingless bees of the genus *Trigona*. It was found that there were four species of the larger *Trigona* and at least two of the minute *Trigona* sub-species *Hypotrigona*. The *Trigona hypotrigona* species do not make combs; the brood cells are arranged in irregular clusters and the honey and pollen is stored in waxen pots. The *Trigona hypotrigona*, or sweat bee, nests in hollow trees and holes in walls, and has a tiny trumpet-shaped waxen entrance to its nest. The honey, what there is of it, is delightful, but the quantity of wax produced is insignificant. More attention was paid to the larger *Trigona* as their wax has been used as an adulterant of bees-wax.

The four species were found to be as follows:—

(1) *Trigona denotii*, Vachal, a ground-nesting species with a wide range of yellow colour variation of the face and in the strength of the bands on the abdomen. All the colour varieties described variously as *Trigona clypeata*, Friese, *T. quagga*, Strand, *T. lendliana*, Friese, and *T. nebulata*, Smith, have been found in the same nest, the progeny of one queen. The nests are usually found

associated with termites, and are often to be found close to the fungal and larval galleries of the termite nest. *Trigona denoiti* builds horizontal single-sided brood combs in a spiral staircase formation.

(2) *Trigona togoensis*, Stadelman, nests in large hollow trees and sometimes in native beehives. This species also builds horizontal single-sided brood combs but development differs from *T. denoiti* in that there is no spiral formation. Egg-laying commences in the centre of each comb. The larger and most-developed combs are at the bottom, and each one above is successively smaller, the eggs and youngest larvæ always being round the outside of each comb. The development of the brood nest proceeds upwards in a conical form. When the fully developed brood commences to emerge from the centre of the lowermost comb a space is formed by the removal of the old larval skin cells, and the queen returns to the bottom of the nest and commences a new cone of brood in the space. A gap is left between the rings of emerging brood and the cone of young brood. This space often has, in addition to the usual waxen pillars, a partial involucre, screening the old brood from the new. This species will set about any marauding honey bees with a will, hanging on to the leading edges of the honey bees' wings with their powerful mandibles. With the stingless bees in this position the honey bees are unable to sting or bite them and have to retreat.

(3) *Trigona beccarii*, Gribodo, is another species with colour variation. These variations are described as *jemberensis*, Cockerell, *nigri-facies*, Friese, *T. topiorum*, Cockerell, *T. can-radii*, Friese, and *T. alinderi*, Alken. These varieties arise from different amounts of yellow coloration on the face, all of which can be seen in the progeny of one queen. There is also a yellow margin on the top of the thorax and yellow bands on the abdomen. *T. beccarii* is a ground-nesting species, build-

ing its nest fairly near the surface. No nest has been found deeper than one metre. The brood combs show the same conical development as *T. togoensis*.

(4) *Trigona standingeri*, Gribodo, is a long, thin-bodied species of belligerent nature. If its nest is disturbed it attacks in force, biting, going for eyes, ears and nose, and smearing one with sticky wax. It builds its nest outside trees on the underside of branches. The exterior of the nest is coated with plates of cerumen and the entrance merely consists of a thickening of the inner labyrinthine wall and the absence of outer plates. The brood combs are double-sided and hang vertically in vertical folds and this is the only species of *Trigona* in whose nest this brood formation has been observed. This form is unique among the Meliponidæ. The New World species, and, as far as is known, all the other Old World species, build either single-sided horizontal combs or merely irregular clusters of brood cells. The brood nest does not develop in the form of a rough sphere extending outwards in concentric layers as in *Apis*. Instead the queen starts laying at the top in newly built cells, and at the same horizontal level in each comb. The bottoms of the combs are therefore level and contain the newly laid eggs and the upper parts of the comb contain more advanced brood, all at the same stage of development in each horizontal section. As the fully developed bees emerge from the uppermost cells of each comb, the cocoons of larval skins are removed and replaced by an open structure of branching wax pillars. Above this pillar structure new brood cells are built and provisioned. The horizontal space containing the wax pillars is thus constantly moving downwards as mature bees below it emerge and new cells above it are being built.

The above four species of *Trigona* and their nests and waxes have been more fully described by the writer in a paper entitled "*Trigona* bees and their waxes".

PROGRESS IN AFRICAN AGRICULTURE

An outline of post-war improvements in Kenya

For the past six years the policy of the department has been directed along four main lines; firstly to secure the adoption by the whole farming community of agricultural practices which will stabilize the soil; secondly to investigate and devise sound farming systems and improved methods of cultivation which will restore and maintain fertility; thirdly, to persuade progressive farmers to adopt a balanced system of farming which must give a return not less attractive than salaried employment and, fourthly, to extend agricultural education to as wide a circle as possible.

In all densely populated areas of Kenya it has been necessary to concentrate on a mass effort to prevent destruction of the land by misuse before it has been possible to plan for individual farmers on their own holdings.

Increases in Agricultural Staff

During the development period, the Colony staff of 23 Agricultural Officers and 461 Agricultural Instructors has been increased by the addition of 70 Assistant Agricultural Officers, 15 Assistant Agricultural Officers (African) and 223 Agricultural Instructors, and 70 River Scouts. These have been paid for from D.A.R.A. and A.L.U.S. sources to augment agricultural instruction and development in African districts. Many more Assistant Agricultural Officers (African) would be employed if available, but in recent years no Africans have offered themselves for training in agriculture at Makerere. £270,000 is being spent each year on the Field Services of the Agricultural Department working on African areas alone, exclusive of any direct or indirect contribution from the specialist and research services of the department.

Soil and Water Conservation

This staff is employed on soil and water conservation work in the African areas and on improving systems of farming and management of grasslands. An indication of an average year's work is given by the following list of conservation works completed in the Central Province during 1951:—

Conservation Works in Central Province in 1951

<i>Treatment</i>	<i>Acres</i>
New terraces	69,060
Terraces renovated	88,996

<i>Treatment</i>	<i>Acres</i>
Bench terraces	590
Grass planted	42,491
Bush cleared	23,320
<i>Numbers</i>	
New cattle sheds built	4,045
Cattle sheds emptied of manure	8,370
Compost stacks or pits in use	28,053
Trees planted	1,312,902

A special reconditioning scheme has been drawn up for the Machakos District. This scheme is run by experienced staff from the Administration and Agricultural Departments, augmented by staff from A.L.U.S. which contributes £34,000 a year and capital funds of £32,000. The individual and communal effort to improve farming is being supported by mechanical soil conservation and dam construction works.

In Nyanza Province in the Highland Division of South Nyanza and in the Buret and upper Belgut and Sotik Divisions of Kericho, about 95 per cent of the land under cultivation has been protected against erosion with trash lines and grass filter strips. Other areas of the Province are less well protected but good progress is being made. In Bunyore and Maragoli good work has been achieved in soil conservation and in compost-making. In the Rift Valley Province 10–20 per cent of the land has been adequately protected, while 80–90 per cent enjoys some form of protection.

The principal developments in extension work have therefore been a wide cover of soil conservation measures, improvement of the land by grass- and tree-planting, by bush-clearing, by controlled grazing schemes and by the preparation and application of manure and compost. This work has been particularly aided in the Nyanza Province by a reward-for-merit scheme paid from African Betterment Funds. Farmers who adopt effective measures for soil control, manuring and resting land under grass, receive assistance in the form of equipment, such as wheel-barrows or fencing, or labour to develop their holdings. They become eligible for further rewards as they diversify their cropping, control their grazing, limit their livestock to the carrying capacity of the land and effect tick control, hedging and good crop, wattle and tree husbandry. In

Nyanza £16,786 was paid out in 1951 to 1,538 progressive farmers, of whom 1,062 were Kipsigis.

Water Supplies

An important factor in the correct use of land in the drier parts of Kenya is the provision of adequate water supplies. The Agricultural Department runs three heavy mechanical dam construction units of which two normally work in African areas. In 1951 nine large dams storing 71,000,000 gallons of water were constructed in North Nyanza, while in 1950/51 17 large dams were constructed in Machakos. In 1952 and 1953 two dam construction units will be working in Central and South Nyanza and in 1954 it is hoped that a unit will go to Kitui District. In addition, contracts were arranged for dam construction in Kericho and Central and South Nyanza. Many schemes for dam construction by local units have been financed by D.A.R.A. and A.L.U.S., e.g. in the coast hinterland, Kitui, Machakos, Nyeri and Masailand. Expenditure on water supplies in African areas up to the end of 1951 totalled £71,000, including £50,000 in Machakos, and is continuing at an annual rate of £18,000.

Agricultural Investigation

During the development period, the establishment of qualified research and specialist officers in the department has been increased by 16 to a total of 35, out of which 29 posts are at present filled. There has also been an increase in the subordinate establishment. The annual recurrent cost of the research and specialist services is at present £140,000. Since the activities of the majority of the staff are divided between the problems of African and European agriculture, it is impossible to say with any accuracy what proportion of the time of the staff or of the expenditure is directly applied to African interests, but it may be roughly estimated at one-third of the total. Eight out of ten Agricultural Officers and Assistant Agricultural Officers newly appointed for experimental work are stationed in African areas. A total of approximately £260,000 has been voted for capital developments to improve research facilities. Of this, £135,000 is for new Central Laboratories and for Pasture Research, both of which serve both African and European interests. Of four new main experimental stations, three are solely for African agriculture, and these, together with the cotton research station mentioned below,

are estimated to cost £61,000. The new experimental stations in Central and Coast Provinces are already in operation, that in Nyanza is not yet established. Ten new sub-stations are in operation. In the sphere of general husbandry, investigational work in African areas aims at evolving farming systems and agricultural methods suited to local conditions, which will enable production to be increased and, at the same time, ensure the maintenance of improvement of soil fertility. Thus in Machakos District, much of which is typical of the vast semi-arid areas of Kenya, experimental work is proceeding along the following main lines:—

- (a) To find the best methods of re-establishing a grass cover on the overgrazed and severely eroded lands of the reserve. Considerable success has been achieved and pastures capable of carrying a beast to the acre over nine months in the year have been established on what was formerly bare, eroded land.
- (b) To work out details of farming systems for both the more favoured parts of the district and for marginal areas, including improved methods for arable cultivation and the provision of fodder crops for dry-season feeding.
- (c) To determine the best methods of grazing management for the large areas of grassland suitable for ranching but too dry for cultivation.

The results of this work will be of great value in supporting the schemes of resettlement at Makueni and of land reconditioning in the reserve, which are already in progress under the ægis of A.L.U.S. The information obtained will also be of value in other semi-arid areas, such as the Kamasia, West Suk and Masai country, where, so far, experimentation is only on a small scale. Similar investigations on lines appropriate to the local conditions are proceeding in other African areas, in all provinces. In all this work the selection of suitable grasses and legumes for leys, methods of ley establishment, and methods of management of both leys and permanent grass play a big part. The newly established pasture research section is devoting much of its time to the problems of African areas and one reason for the establishment of the central grassland research station at Kitale was that it is in an ecological zone typical of the major

part of the African areas of Nyanza Province and also occurring extensively in Central Province.

The use of fertilizers and manures is likely to play an increasingly important part in African agriculture. Experiments on rates and methods of applying cattle manure are in progress at a number of stations. An extensive series of fertilizer trials carried out by E.A.A.F.R.O. in Nyanza Province over three years is now being continued by the department, and similar trials have also been started in Coast and Central Provinces. Large and economic responses to fertilizers have already been demonstrated in some areas. The selection and improvement of food crops is receiving considerable attention. The production of short-term, drought-resistant and high-yielding varieties of maize and sorghum (especially the latter), for the drier African areas is a project of great importance. In the absence of adequate plant-breeding staff, work has so far been confined to testing imported varieties. The testing of cassava varieties, bred at Amani, to be resistant to the diseases brown streak and mosaic, is proceeding and is likely to yield highly beneficial results. Variety trials are also in progress with beans, finger millet and rice.

Experimental work on cash crops has been considerably increased. A cotton research station has been established at Kibos, in Nyanza Province, with sub-stations at Homa Bay and Bungoma. A cotton specialist from the Empire Cotton-growing Corporation has been at work since early 1951, and progress is being made against the problems of Black-arm disease and insect pests which greatly reduce production. A superior variety has already been introduced throughout North Nyanza and seed of a second variety is being bulked for issue in Central and South Nyanza. Work aiming at the introduction of a better cotton variety for the coast is in progress. The Coffee Research Team is assisting in the development of African coffee growing and has over 50 variety trials in African areas. The production of better strains of pyrethrum, and the results of other experimental work on this crop, will assist the African grower. Sugar trials have been initiated in suitable parts of Nyanza Province with a view to developing African growing, initially for the production of jaggery but with brown sugar manufacture in view as a later possibility. Work is in progress on the selection, cultivation and control of insect pests of the coco-nut, which is a crop

of great importance at the coast. The work of the horticultural section is assisting in the development of fruit and vegetable production by Africans. Numerous variety trials have been conducted with vegetables and the experimental work on pine-apples now in progress is likely to benefit the increasing number of Africans growing this crop in Central Province. At the coast, the horticultural station at Matuga has for several years been producing high-grade citrus trees for African cultivation and assisting in the development of small African-owned citrus orchards by giving supervision and advice. This station has also been endeavouring to increase and improve the cultivation of other fruits by Africans.

Development of Balanced Economic Holdings

While the first aim of the Agricultural Department has been to secure a general adoption by the community as a whole of measures to prevent loss of soil and fertility before the damage is irreparable, the second has been to bring prosperity to the African farmer by helping him to plan and develop an economic holding in those African areas of Kenya having a reasonable rainfall. The basis of the development of an economic holding is good-quality grass which will maintain a productive cow and a high-priced cash crop to help pay for the capital development of the holding. The aim, which is within sight, is a gross income of £100 a year over and above feeding the family. This development has been rendered difficult by the indigenous system of inheritance in such areas as the Kikuyu land units at Bunyore and Maragoli, whereby a man's land is fragmented into many small and separate fields. In those areas the problem of land tenure must be dealt with before satisfactory progress can be made. It is in areas such as Kericho, where population pressure on the land has not been so great, that the greatest developments have taken place. Nevertheless, the demand is there from other areas and, in Nyeri alone, the Agricultural Officer has a waiting list of 200 applicants for farm planning. The growing of coco-nuts, cashew nuts, cotton, coffee, pyrethrum, pine-apples, tea, tobacco, fruit and vegetables by Africans is being expanded steadily. The following table shows the value of the more important cash crops grown by Africans surplus to their requirements and sold in Kenya markets in 1951. The value of produce sold by African farmers is far in excess of

£3,265,558 because of the large sales and exchanges to each other at markets and sales to people in the big towns such as Nairobi and Mombasa, of coco-nuts, charcoal, fruit, flowers and vegetables.

Sales of Surplus African Cash Crops

Commodity	1946	1951
	£	£
Cereal crops (maize, millet, sorghum and wheat) ..	346,133	827,895
Cotton lint and seed ..	56,161	385,462
Wattle bark ..	153,730	381,936
Sisal (African grown) ..	Nil	343,604
Hides and skins ..	250,000	320,151
Pulses (beans, grams, cow-peas, pigeon peas) ..	121,520	304,898
Vegetables, flowers, fruit ..	204,381	171,764
Root crops (cassava, potatoes) ..	45,464	81,690
Coffee ..	4,800	70,700
Poultry and eggs ..	54,724	68,477
Miscellaneous (bees-wax, cashew nuts, chillies, castor seed) ..	11,164	66,991
Fuel, poles and charcoal ..	—	66,230
Oil seeds (copra, groundnut, simsim) ..	64,142	52,721
Rice ..	15,981	45,418
Ghee ..	43,751	42,673
Tobacco ..	5,791	29,618
Pyrethrum ..	Nil	8,320
	£1,377,742	£3,268,558

The policy of the Agricultural Department for the future is to develop a farm planning service to farmers in those areas where economic holdings have been consolidated in order to enable the farmer to lay out his land. He will be advised how to develop it on sound and productive lines, utilizing his resting grass economically and growing suitable high-priced cash crops. The large wattle industry in the Central Province and the maize production of the Nyanza Province have made the main cash contributions up to the present. The growing of high-priced cash crops is being developed in an orderly manner in suitable areas, due attention being paid to proper processing and marketing, mainly on a co-operative basis, to ensure quality and standardization. Strains of cotton resistant to pests and disease are being introduced into the Nyanza and Coast Provinces. Plans have been prepared for increased plantings of coco-nuts at the coast. By the end of 1951, 8,208 Africans were growing coffee on a total of 1,735 acres and large coffee nurseries in each of the Meru, Embu, Nyeri, Fort Hall, Kiambu, North Nyanza, South Nyanza and Teita Districts were in operation for the distribution of coffee

seedlings to farmers who had approved sites prepared. Nurseries are being increased to enable some 2,000 acres of coffee a year to be planted. A high standard of cultivation has been required to produce high yields and to combat pests and diseases and this has been fully justified by the good classifications obtained for African-grown coffee sold so far. Similarly, by the end of 1951, 766 acres of pyrethrum had been planted in the Kiambu, Nyeri, Meru and South Nyanza Districts and had been authorized for Fort Hall and Embu. The acreage under African-grown pyrethrum will be steadily expanded in the altitude zone to which it is suited. An experiment in the growing of tea by Africans has been commenced at Kagochi on Mount Kenya and early plantings are doing well. As this project will cost £70,000 for nurseries and to set up the factory to serve some 500 acres of tea, the success of this scheme must be assured before other tea ventures can be embarked upon. Flue-cured tobacco growing is a developing industry in parts of Fort Hall, Embu, Kitui and Meru, 1,334,342 lb. of green leaf being sold in 1951. In regard to sisal, facilities for the sale of leaf by Africans to established factories have been granted in many districts, while in Machakos the African District Council has established its own brushing and baling plant and, from its revenues from the sisal cess, has advanced £25,000 to enable the Agricultural Department to operate the Marketing Scheme. Over 1,000 acres of pine-apples have been planted in Kiambu for sale to canners. In Nyanza the growing of sugar is being encouraged. With the big demand for rice in Kenya and in the Far East, the possibility of expanding rice production is being explored in the Coast Province, particularly on the Tana, Sabaki and Uмба Rivers, and in Nyanza under irrigation and in swamps.

When produce is marketed, it is most important that it should be clean, dry and of good quality. Otherwise it will be severely damaged in storage by pests and diseases or purchasers may refuse to buy it. In order to ensure that good markets are maintained for growers, the control of marketing and inspection of produce devolves on the Agricultural Department to the point where maize and produce is accepted by Maize and Produce Control, wattle bark by the wattle companies, or cotton to the point of delivery to the purchasers of cotton lint. This work is supervised by nine Marketing Officers under whom is a large staff of African Produce Inspectors,

while there is a separate staff for wattle inspection. For fresh produce, the establishment of the Kenya Horticultural Union in 1952 provided a wanted outlet. Numerous co-operative societies exist for the marketing of coffee, pyrethrum, maize, ghee, poultry and eggs in Nyanza Province, of coffee and pyrethrum in the Central Province and vegetables from the Teita Hills in the Coast Province, all of whose marketing activities receive attention from the field staff of the Agricultural Department.

Agricultural Education

As it is important that agricultural instruction should begin with the young, staff of the Agricultural Department make a special point of assisting schools with the development of their gardens and in organizing and judging competitions between them, as for the Watson Shield in North Nyanza. Preparation of manure and compost, bench terracing and rotation of crops are widely practised in school gardens. A more recent development is the formation of Young Farmers' Clubs and Better Farmers' Societies and this is being encouraged by the formation of a union of such clubs throughout Kenya. As women play a vital part in agriculture, an increasing number of Female Agricultural Instructors are being employed, particularly in Kericho, Nyeri, Fort Hall and Machakos. Agricultural Instructors are trained at three schools, the Combined Training Centre at Siriba, run and financed by the Education Department for Nyanza, at Embu for the Central Province and at Matuga for the Coast Province. The capital grant of £24,000 for the Siriba and Embu schools was provided from a Colonial Development and Welfare grant, while the £9,000 for Matuga was met from the Coast Cotton Sales Fund. Annual recurrent expenditure on the Embu and Matuga schools is £7,500. From these three schools vacancies in the staff of the Agricultural Department are filled on African Civil Service terms. These schools and the Bukura Farm Institute run numerous refresher courses for Agricultural Instructors and for school teachers.

Another development is the formation of farm institutes in the Nyanza Province at which a farmer and his wife live and run a holding under instruction for a year. The Bukura Farm Institute has been running 20 holdings on these lines for a number of years and farm institutes are now being developed in the other districts of Nyanza Province. Capital funds for this purpose are derived from the Nyanza Cotton Sales Fund and recurrent expenditure is met by African District Councils. While the Bukura Institute has been financed initially by A.L.U.S., to a total of £18,000, the recurrent expenditure of £2,500 is to be taken over gradually by North Nyanza African District Council.

Conclusion

This development is advisedly not based on a policy of grandiose and spectacular schemes, but rather on an accumulation of many small schemes adapted to the varying conditions of different parts of Kenya, aimed at the African peasant over the widest possible field. There is no short-cut to full productivity of the land, especially in Africa where patience, persuasion and perseverance are the keys to progress.

Nevertheless, during the development period certain major achievements can be recorded. Firstly, an ever-widening cover of effective conservation works, and much-improved water supplies; then greater technical knowledge of how best to farm the varying zones of Kenya; and lastly, more and more individual Africans adopting improved farming methods, including valuable cash crops, and more and more Africans trained in agriculture at the increased number of training centres. The basis of better farming is now spreading very widely among Kenya Africans, and ever-increasing numbers, including women, are accepting and responding with good will to advice about their crops and livestock. So, despite serious difficulties such as traditional systems of land tenure in certain areas, the general outlook for the future has greatly changed during the development period and is now far brighter than it was six years ago.

THE SPREAD OF *ARMILLARIA MELLEA* (Fr.) Quel. IN TUNG ORCHARDS

By P. O. Wiehe, Plant Pathologist, Department of Agriculture, Nyasaland

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INTRODUCTION

The fungus *Armillaria mellea* (Fr.) Quel., is one of the serious pathogens affecting the tung oil tree *Aleurites montana* in Nyasaland. Death from root rot and decay of the lower portion of the trunk is frequent in certain areas and often results in significant economic losses. Tea which is cultivated in Nyasaland under similar climatic conditions as tung, is also susceptible to attacks by this fungus and the host-parasite relationship was studied in detail by Leach (1937, 1940), who was able to demonstrate that a supply of carbohydrates in the tissues is an essential condition for parasitism. Leach further showed that the foci of *Armillaria* infection in tea gardens were the stumps and root systems of indigenous trees left in the ground after felling. As a result of these investigations he recommended that before establishing tea gardens in virgin woodland areas, indigenous trees should be ring-barked, so as to deplete the root systems of their carbohydrate reserves. Since the factors involved are the same, these recommendations are equally applicable in the case of new tung plantations and indeed of any woody crop liable to infection by *Armillaria*.

The host range of the pathogen is most extensive (Wormald, 1949), and records of its occurrence in Nyasaland include a large number of indigenous and cultivated plants (Wiehe, 1952). The practice of ring-barking trees in virgin areas before planting has been widely followed in recent years in the tea and tung districts of Nyasaland with an evident decrease in incidence of *Armillaria*. The purpose of this paper is to present quantitative information on the magnitude of these beneficial effects as well as to provide further data on the spread of *Armillaria mellea* once the fungus has become established in a tung orchard.

PRESENTATION OF DATA

The data presented in this paper were obtained from records and observations made at the Tung Experimental Station, Cholo, and I am grateful to Dr. C. C. Webster and Mr.

J. A. Sandys for their invaluable assistance and co-operation in obtaining the necessary information. The natural vegetation of the Tung Experimental Station is an open deciduous woodland in which the more important species are *Brachystegia longifolia*, *B. spicaformis*, *B. velutina* ("Kamphoni"), *Parinari mobola* ("Muula"), *Isobrerlinia globiflora* ("Mchenga") and *Uapaca kirkiana* ("Msuku"), the density of stocking varies from 40 to 75 trees per acre. From the point of view of *Armillaria* infection the deciduous species *Isobrerlinia*, *Parinari* and *Brachystegia* are the more dangerous, as abundant reserves of carbohydrates are stored in their root systems. In this connexion Leach has observed that the roots of *Parinari* may remain alive in the soil for considerable periods after felling.

According to records of the Experimental Station, tung plantations were established in the following way: wherever possible woodland trees were ring-barked and tung trees planted two years later. In several instances, however, ring-barking was not practical as individual trees had already been felled for firewood; in such cases the root systems were removed as thoroughly as possible after stumping. Finally, other localized areas were treeless, having been under cultivation of arable crops for many years. The routine practice followed at the station is to cut down trees infected with *Armillaria* as soon as the disease is diagnosed, removing the root system as thoroughly as possible and cutting trenches about 2 ft. deep in a square from 10 to 15 ft. around the trunk. Replacement of trees is usually carried out two years after uprooting.

The annual incidence of *Armillaria* on tung trees was studied from records of individual fields having the following histories: (a) woodland trees ring-barked two years before planting; (b) woodland trees not ring-barked before planting, with stumps from previous fellings scattered throughout the area; (c) plantations established on fields which had been under cultivation of annual crops for an estimated period of 20 years.

Several inspections were made during each growing season which extends approximately from October to April, and the position of infected plants mapped on plans of the fields under study (Figs. 3, 4). In this way information was obtained on numbers of infected plants as well as foci of infection. In the analysis of data, a focus of infection is considered to be an area where one, two, or more adjacent trees are attacked by *Armillaria*.

The results obtained are shown in Tables 1 to 4. In order to be comparable, data on numbers of infected trees and foci of infection in Tables 1, 2 and 3 are converted on a unit area of ten acres in Table 4, which shows in addition the theoretical yields of *Aleurites montana* at different ages as recorded by Webster (1950). Losses are expressed in terms of oil per acre on the basis of an average oil content of 30 per cent in the air-dried nuts. It should be pointed out that in evaluating losses, yield of trees replanted at the site of those which succumbed from *Armillaria* has not been taken into account, since a minimum period of five years must elapse before replacements start to bear a crop.

With a view to determining whether different clones of *Aleurites montana* showed a varying degree of susceptibility to *Armillaria mellea*, data from a field planted with ten clones and where incidence of the disease was high were examined statistically; there was no significant difference between disease incidence and any particular variety.

TABLE 1

INCIDENCE AND SPREAD OF *Armillaria mellea* ON *Eleurites montana* ESTABLISHED ON AN AREA IN WHICH WOODLAND TREES HAD BEEN RING-BARKED TWO YEARS BEFORE PLANTING

Area of field—20.4 acres.

Total number of trees planted—1,131.

Planting date.—November, 1943.

Age of trees (years)	Number of deaths due to <i>Armillaria</i>	Number of foci of infection
6	9	7
7	4	7
8	5	10

TABLE 2

INCIDENCE AND SPREAD OF *Armillaria mellea* ON *Aleurites montana* ESTABLISHED ON AN AREA IN WHICH WOODLAND TREES HAD NOT BEEN RING-BARKED, AND IN WHICH SPORADIC FELLING OF TREES HAD BEEN CARRIED OUT FOR MANY YEARS

Area of field—5.5 acres.

Total number of trees planted.—303.

Planting date—November, 1942.

Age of trees (years)	Number of deaths due to <i>Armillaria</i>	Number of foci of infection
5	1	1
6	15	11
7	21	14
8	22	16
9	2	16
10	3	16

TABLE 3

Area of field—6.8 acres.

Total number of trees planted—378.

Planting date—November, 1940.

Age of trees (years)	Number of deaths due to <i>Armillaria</i>	Number of foci of infection
6	1	1
7	7	5
8	1	5
9	3	7
10	2	8

DISCUSSION

A study of data presented in Table 4 and expressed graphically in Figs. 1 to 4 reveals beyond any doubt the effect of ring-barking woodland trees on the incidence of *Armillaria mellea* on tung plants. Thus, after a period of eight years ring-barked areas showed a decrease in infection amounting to 17.8 per cent passing from 19.4 per cent of infected trees in a plantation established directly after felling to 1.6 per cent in another in which woodland trees had been previously ring-barked. There were 29 and 5 foci of infection respectively, but the foci were larger, often involving many trees in the non-ring-barked

areas. The calculated amount of oil lost is approximately ten times larger in non-ring-barked areas. At the ruling price of tung oil in 1952 these losses during a period of eight years are equivalent to £17 and £1/10 per acre respectively in the two cases under consideration. After ten years the monetary losses caused by *Armillaria* amounted to £54 per acre in an orchard established on a non-ring-barked area. Any disadvantages, therefore, which may be attendant to the ring-barking of woodland trees are largely compensated by the smaller number of casualties due to *Armillaria*.

It is important to note, however, that infection is not entirely checked by ring-barking woodland trees. In such cases the primary source of infection may be either from—

- (a) roots of shrubs and small trees which it is not possible to ring-bark for practical reasons;
- (b) infected stocks from nurseries;
- (c) soil contamination by infected implements;
- (d) infection from spores.

In connexion with the last mode of infection, sporophores of *Armillaria mellea* have on several occasions been observed developing at the base of infected trees. It is reasonable to assume, therefore, that spore infection does take place, but unfortunately no observations are available on the mechanism of primary infection occurring by this mode.

Data in Tables 3 and 4 give further evidence that there are probably other sources of infection than woody roots left in the soil before planting, since 14 trees contracted infection in an area of 6.8 acres despite the fact that the land had been under continuous cultivation of annual crops for a long period before tung trees were planted.

Once the fungus has become established in an orchard, its spread probably takes place chiefly by contact of infected with healthy roots; rhizomorphs were seldom observed and were invariably short, rarely exceeding 6 in. From Fig. 3 it may be seen that in several cases the fungus had spread 90 ft. away from a primary focus of infection. An indication of

the rate of spread may be obtained by the ratio:

$$\frac{\text{Number of infected trees}}{\text{Foci of infection}}$$

and when this is done with data in Table 4 it is found that the ratio for a period of eight years is 3.8 in non-ring-barked areas, 2.2 in ring-barked areas and 1.7 in fields previously under arable crops. Thus the rate of spread of the fungus is nearly double in plantations established directly after felling woodland trees. As already explained, diseased trees were isolated by trenches; the conclusion, therefore, is that while trenching has given some measure of control in ring-barked areas and others which have previously been under cultivation, the spread of the fungus has not been checked by this method in woodland areas which had not been ring-barked. These differences may be accounted for by the fact that in non-ring-barked areas the foci of infection are wider, infective material is more abundant and is already present beyond the trenches when they are dug out.

In all the cases studied, the critical period for infection appears to be when tung trees are in their sixth to eighth year, thereafter there is a marked reduction in number of new infections, the ratio of spread passing from 1.5 in the seventh year to 0.2 in the tenth year in plantations established on non-ring-barked woodland areas. Similarly the ratio decreases from 1.4 to 0.2 in fields which had been under previous arable cultivation. This decrease is difficult to explain, unless there is a gradual building up in the soil of organisms antagonistic to *Armillaria*. It is hoped that this problem will form the subject of further investigations.

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TABLE 4

Comparative incidence, spread and losses due to *Armillaria mellea* in tung orchards established on ring-barked (A), non-ring-barked (B) and woodland areas and fields previously under cultivation of arable crops (C). Age of plantations in 1951: A, 8 years; B, C, 10 years.

Age of orchard (years)	Number of trees killed by <i>Armillaria</i> , 10 acres			Foci of <i>Armillaria</i> infection, 10 acres			Theoretical yield, lb. oil per acre	Lb. oil lost per acre			Oil lost expressed as percentage of theoretical yield		
	A	B	C	A	B	C		A	B	C	A	B	C
3	—	—	—	—	—	—	78	—	—	—	—	—	—
4	—	—	—	—	—	—	158	—	—	—	—	—	—
5	—	—	—	—	—	—	293	—	—	—	—	—	—
6	—	2	—	—	2	—	360	—	—	—	—	—	—
7	4	28	1	3	20	1	450	3.0	1.2	0.8	0.5	6.2	0.2
8	2	39	10	3	25	7	540	5.6	22.5	10.3	14.4	2.3	2.3
9	3	41	1	5	29	7	608	10.1	64.9	13.4	20.5	2.4	2.4
10	—	4	4	—	29	10	672	—	111.1	20.1	23.6	3.3	3.3
	—	6	3	—	29	11		—	143.6	26.6	25.0	4.0	4.0

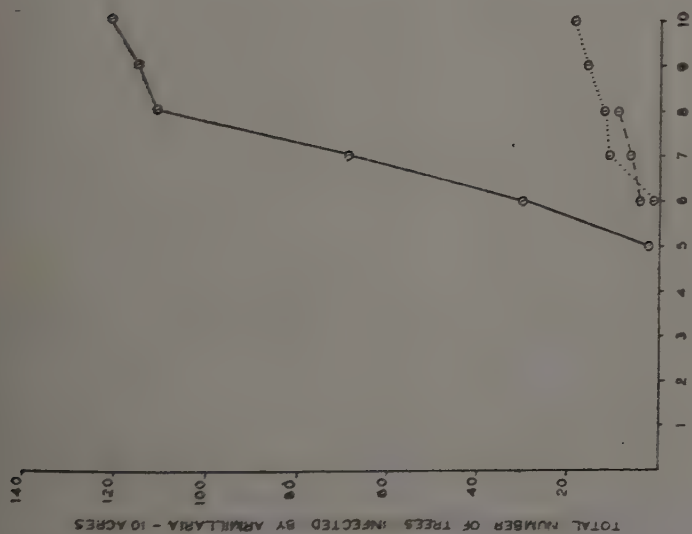


Fig. 1.—Incidence of *Armillaria mellea* on *Aleurites montana* in non-ring-barked areas (plain line), ring-barked areas (broken line), and in fields previously cultivated.

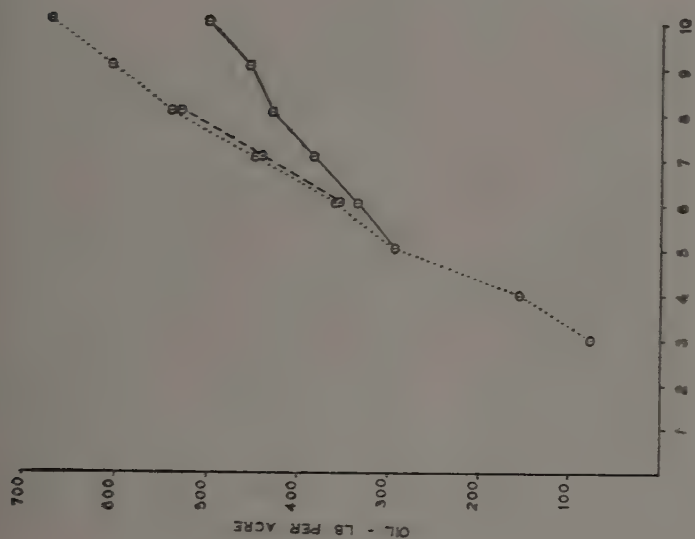


Fig. 2.—Yields of *Aleurites montana*: theoretical (dotted line); orchards established on ring-barked areas (broken line), and orchards established on non-ring-barked areas (plain line).

TREES INFECTED IN 5TH. YR. ■; 6TH. YR. ●; 7TH. YR. ⊗; 8TH. YR. ▧; 9TH. YR. ▨; 10TH. YR. ▩

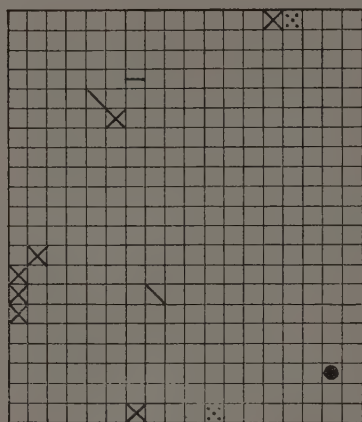
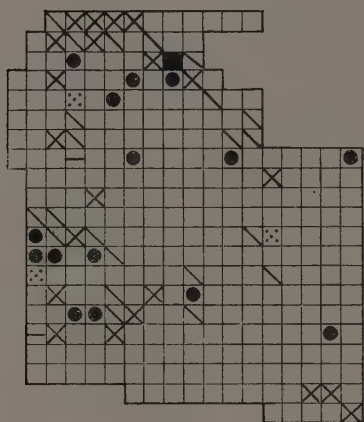


Fig. 3.—Incidence of *Armillaria mellea* on *Aleurites montana* planted on non-ring-barked areas, A; and areas previously under cultivation of annual crops, B. Each square represents one tree. Planting distance, 30 feet.

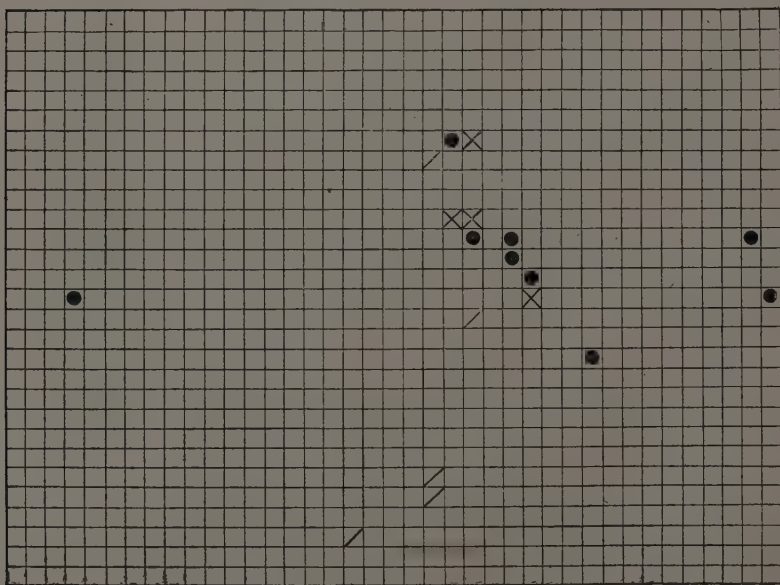


Fig. 4.—Incidence of *Armillaria mellea* on *Aleurites montana* planted on ring-barked areas. For explanation of symbols, see Fig. 3.

INTERCEPTION OF RAINFALL BY CYPRESS PLANTATIONS

By H. C. Pereira, Soil Physicist, E.A.A.F.R.O.

On the catchment area of the Aberdares, the reception of rainfall by indigenous or plantation trees, and the proportion of the water passed on to the deep water-table, is a matter of great practical importance. The vital need to protect Nairobi's water supplies, together with the great economic potential of softwood plantations in these areas, has led to detailed research into the effects on water supplies of the replacement of indigenous bamboo by plantations of cypress and pine. The first part of this study concerns the fraction of rainfall reaching the ground.

Wimbush (1947) described an experiment begun in 1946 by the Kenya Forest Department, in co-operation with the E.A. Meteorological Department, in order to measure the proportion of rainfall reaching the ground under a 20-year-old plantation of Montleroy Cypress (*C. macracarpa*) and under nearby natural bamboo forest (*Arundinaria alpina*). Rainfall penetration, drip from the canopy, and run-off down the stems were measured by 41 separate gauges, distributed under a random sample of each size of tree in a one-acre plot of each cover. These plots are near Kinale on the eastern edge of the Rift Valley at an altitude of 8,700 ft. Wimbush quoted the results for the first five months only, because of his departure from the Colony. The daily readings of the gauges were continued by the Forest Department as a routine for six years. The somewhat formidable quantity of data resulting has now been analysed as part of an E.A.A. & F.R.O. study of the water use of catchment area vegetation.

The method of calculation from the monthly totals of each gauge, as used by Wimbush, has not been adopted since the proportion of a single rainstorm which reaches the ground may be as little as 20 per cent for light showers, or as high as 95 per cent for very heavy falls. Horton (1919) published a method of analysis which has since been very widely used in the U.S.A., and has been followed here. The percentage interception for individual showers has been calculated for each class of rainfall in each month for the six years. Use of a card-index system has greatly facilitated the subsequent study of these storms. The class intervals used were:—

0.01 in. to 0.10 in.	0.51 in. to 1.00 in.
0.11 in. to 0.25 in.	1.00 in. to 1.75 in.
0.26 in. to 0.50 in.	1.76 in. and above.

No rainstorms exceeding 3 in. were recorded in the six years. Fig. 1 shows the average result, for the whole period, for bamboo and cypress compared with similar data from summer rainfall measurements in a North Carolina forest of mixed hardwoods. The general similarity of behaviour is striking. The curves are hyperbolæ, and thus the data have a linear logarithmic relationship, as shown in Fig. 2, which again emphasizes the essentially similar behaviour of these three very different forest covers. The North Carolina results are from natural mixed forests of hickory, oak and yellow poplar, which form a multi-storied canopy. The agreement of measurements under such dissimilar types of foliage suggests that the relationship is of fairly wide application.

An additional effect of such forest covers, growing in areas of heavy dew and mist, is the condensation of moisture on the foliage. This was not measured in the experiment reported here, although on many occasions one or two "points" of rain were recorded in the gauges under the canopies, while those in the open "control" clearings remained empty.

The 20-year-old cypress had been pruned high before the experiment began in 1946, and in each subsequent year, the growth at the top of the tree has increased the density of the canopy. This has increased the interception of all but the heaviest showers, as illustrated by the curves for the first and last year of the experiment (Fig. 3). The plantation is now due for thinning, which will, of course, substantially decrease the interception of rainfall. The bamboos have also showed a steady increase in interception of all types of rainstorm, showing that, although they had appeared originally to be a mature stand, the clumps have been increasing in density, possibly in recovery from an earlier drought. This increase is confirmed by observations of a few individual clumps over the past three years.

It can be seen from Fig. 3b that under the bamboo the measurements of interception of the higher rainfall groups have become increasingly irregular. A detailed study of individual gauge readings has shown that this effect is due to the use of an inadequate number of gauges to sample the highly variable drip and penetration under the bamboo canopy. This

problem has been met, in similar forest studies in the U.S.A., by the use of long, narrow troughs instead of rain-gauges, and by moving the troughs a few feet, in randomized directions, each time they are measured. Despite this handicap, however, the general nature of the bamboo interception curve, and its similarity to those of other forest covers, is not in doubt.

The grouping of all the rainstorms recorded in the $5\frac{1}{2}$ years and the annual interception, is given in Table 1. It will be seen that in the exceptionally dry year of 1949, there were very few storms of more than half an inch of rain, and the percentage interception for both covers was high. Thus both the degree of development of the canopy, and the size distribution of each year's rainstorms affect the proportion of the rain which reaches the ground. The figures suggest a somewhat lower percentage interception by bamboo, but part of this difference is known to be due to the restricted sampling. The cypress interception figures illustrate the maximum development of the canopy before thinning, which was scheduled for 1952.

The general conclusion from this data is that when bamboo forests on catchment areas are replaced by the more profitable cypress plantations, the interception of rainfall is

reduced only during the early plantation and growth stages of the cypress. As the latter develops fully, its average interception equals that of the bamboo, and may, in the intervals between thinnings, exceed it. In the absence of very large-scale experiments in which whole catchment areas are replanted while river flows are recorded, the effects of such changes in vegetative cover must be sought at and below ground-level. Detailed soil moisture measurements of such effects have therefore been in progress for two years.

It is too early to report these soil moisture studies in detail, but a substantial difference has already appeared in one important measurement. The length of time for which the soil is wet enough to permit percolation beyond a depth of six feet has been substantially greater under a cypress plantation than under adjacent indigenous bamboo.

ACKNOWLEDGMENTS

The data for the hardwood forests were supplied by Dr. C. R. Hursh, Chief of the Forest Influences Division of the U.S. Forest Service of North Carolina, whose helpful advice is gratefully acknowledged.

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Horton, R. E. (1919).—*Monthly Weather Review*, 47, pp. 603-625.

TABLE 1
RAINSTORM SIZES AND INTERCEPTION AT KINALE

Rainstorm Classes	NUMBER OF STORMS IN EACH CLASS						Percentage of annual rain falling in each class
	1946	1947	1948	1949	1950	1951	
0.01 to 0.10 in. ..	—	58	52	41	49	66	5.80
0.11 to 0.25 in. ..	—	28	35	24	44	33	13.14
0.26 to 0.50 in. ..	—	32	21	22	20	45	20.09
0.51 to 1.00 in. ..	—	30	18	12	15	26	30.72
1.00 to 1.75 in. ..	—	8	11	3	7	12	22.14
Above 1.75 in. ..	—	5	1	0	3	1	8.09
Total annual Rainfall (inches)	(41.01)	60.60	45.43	25.52	41.52	60.18	

PERCENTAGE OF ANNUAL RAINFALL INTERCEPTED

Cypress	17.2*	19.4	22.7	32.0	28.6	29.0
Bamboo	13.4*	14.5	21.5	25.8	21.5	27.2
Total Interception over $5\frac{1}{2}$ years:	<div> <div>Cypress 25.5 per cent</div> <div>Bamboo 20.3 per cent</div> </div>					

Fifteen year average for spring and summer rainfall interception in a North Carolina hardwood forest, 22.6 per cent.

*Wimbush (1947)

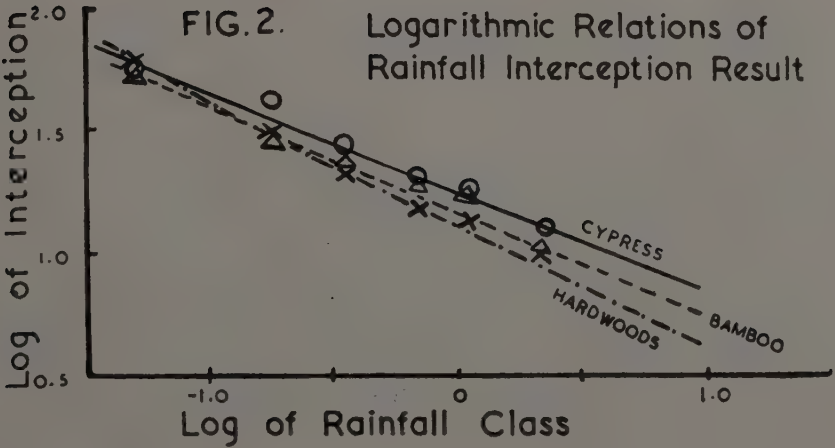
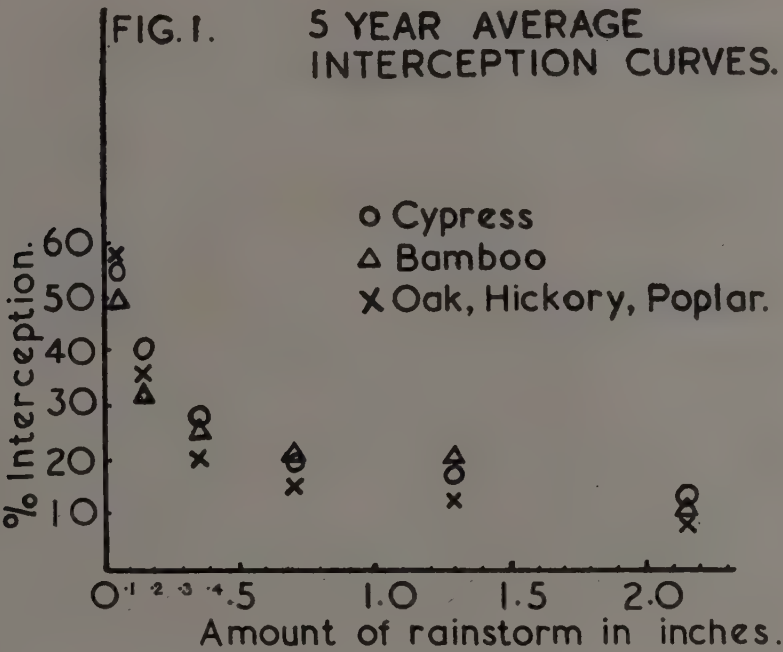


FIG. 3a. INCREASE OF INTERCEPTION WITH GROWTH OF CANOPY.

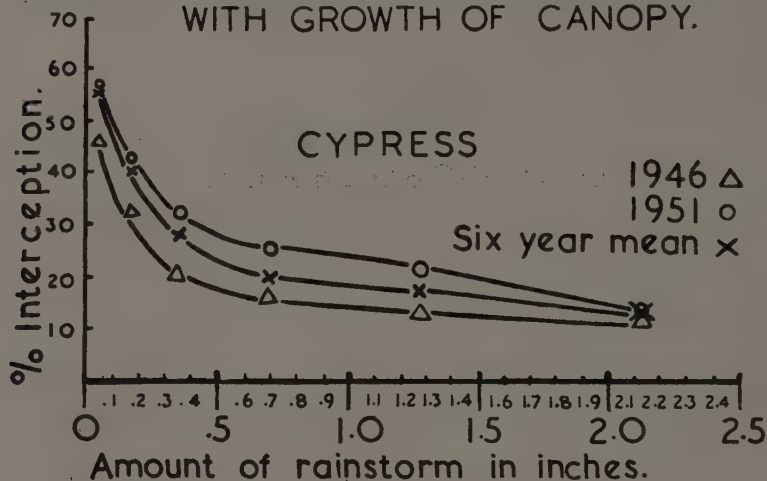
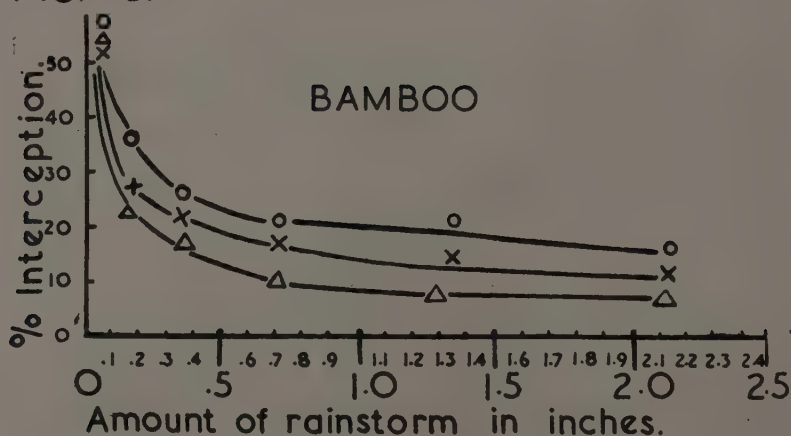


FIG. 3b.



THE DESTRUCTION OF RICE-EATING BIRDS

By N. R. Fuggles-Couchman, Department of Agriculture, Tanganyika

(Received for publication on 21st August, 1952)

Considerable losses of grain occur annually in East Africa due to depredations by birds. While several species are responsible, there are three in particular which do probably 90 per cent of the damage. These are *Quelea quelea ethiopica*, *Quelea erythrops* and *Quelea cardinalis*. In the Northern Province the first and last were responsible for destroying 3,000 acres of wheat on the Ardaï Plain in 1944, and every year varying numbers cause damage to wheat near Arusha, to such an extent that at least one wheat grower has given up wheat production for this reason. Native crops in the Eastern Province, and other areas where suitable nesting sites are available, suffer considerable damage. This applies particularly to rice, which is so often grown near to the most suitable nesting areas. In the Eastern Province the first and second species, particularly the second, are the chief culprits.

In the Sudan *Quelea q. ethiopica* has been a most serious pest of sorghum, so much so that an ornithologist was seconded specially to study their habits and to devise methods of control. It was found that after breeding, the birds flocked in great numbers and migrated to the banks of the Blue Nile, where they roosted in vast congregations in patches of woodland along the river. Blasting the roosts with charges of gelignite spaced regularly in the trees showed great promise and a method has been finally perfected by which a very large measure of control of the birds has been obtained. Attacking the birds after breeding was more effective there, as nesting takes place in rather scattered trees.

Since the pilot rice scheme has been started at Kilangali in Tanganyika severe damage has been suffered by the crop from *Quelea q. ethiopica* and *Quelea erythrops*. It was known that birds nested there in dense "slums", but their roosting habits were only a matter for conjecture. The birds were carefully watched in January this year and it was found that nesting was about to take place in the great area of *Typha* swamp which lies alongside the newly developed fields. As it also appeared that the birds roosted in the nesting area it was believed that there was an opportunity to destroy the nesting population by blasting before or during breeding, with even greater chances of reducing the pests.

The first breeding urge did not develop but a colony of the two species was found on 18th March in another area of 6-ft. to 7-ft. tall *Typha*, with 1 ft. of water in the swamp. The area covered by nests was estimated to be at least 10,000 square yards. Counts of nests near the centre gave 12 occupied nests per square yard, with fewer near the periphery of the colony. A conservative estimate gave 60,000 nests in the area. The minimum number of eggs was two per nest, and several had three to five. This would mean that the nesting birds totalled at least 80,000 as the species are believed to be polygamous. The accretion would be of the order of 100,000 birds.

Due to the birds stripping the *Typha* leaves and roosting in the nesting area the rushes had been broken down to about 4 ft. high over the whole area and nests were mainly at this height. Unfortunately it was impossible to obtain sufficient Cordtex explosive fuse or electric detonators to enable a trial over the whole 10,000 square yards, and only 1,200 square yards could be dealt with.

Laying the Charges

Wooden poles 4 ft. 6 in. high with platforms to hold a flat 10-lb. packet of gelignite were prepared. These were first put into position in the centre of the colony in the early morning. Two lines of four poles were placed 20 yards apart, the poles 15 yards apart in the line. At the centre two more poles were set up each side 10 yards from the centre line, forming a cross. The poles were driven in till they were about 3 ft. 6 in. above the ground.

Cordtex was next laid, joining up all the poles, requiring 450 ft. Next the short lengths of Cordtex to prime the gelignite were strapped to the main line with adhesive tape and string, one primer at each pole. These primers were made from 15 in. of Cordtex double knotted at one end.

Two ten-lb. packets of gelignite were next placed on each platform, the paper being torn on one side to expose the sticks. The knotted end of the primer was placed between the two packets in the space opened by removing the paper. In all, 240 lb. of gelignite were used.

Finally two detonators were prepared, each with 22 ft. of time fuse and each detonator

was separately strapped at the firing end of the Cordtex. The time fuse and all the Cordtex train were supported by tying to the rushes. The area was finished by 10.30 a.m., two Europeans and an African laying the charges with three Africans bringing in loads from the edge of the swamp, directed by a third European.

Exploding the Charges

The time fuses were lighted at 7 p.m., at dusk, when all the birds had settled down. The "Sappers" retired 150 yards behind a convenient ant-hill, and after 12 minutes of anxious waiting and being devoured by mosquitoes, they were relieved to hear a most encouraging explosion.

On emerging from cover a miniature Bikini cloud was seen over the area. Immediate inspection by the light of a torch showed extensive destruction with birds fluttering about outside the immediate area of the explosion.

The Results

Within a radius of six yards of each charge the vegetation had been completely blasted and removed. Bare patches only remained. All birds and nests within the area had been destroyed though corpses were few, largely because within the area devastated the birds had been blown to pieces, and just outside the area the blast seemed to have had little effect.

There had been a complete link-up of blasted areas where the charges were ten yards apart. At 15 yards a small strip remained intact. Outside seven yards eggs in nests were largely intact, but dead birds were found in some nests. Eggs were broken in nests between two charges 15 yards apart.

As only a small area had been blasted the rest of the area still contained large numbers of birds which showed no signs of leaving. A few days later 100 boys were put into the colony and every nest was destroyed, but the adults that escaped the explosion remained. Five more large colonies were later flattened by 100 to 150 boys in two days.

Lessons Learnt

1. It is thought that the charges should have been placed higher, level with the nests, or just above, as the heavy vegetation probably damped the full effect of the blast at the level used.

2. Twenty-pound charges were too small at 15 yards to obtain complete coverage. Thirty-pound charges at 15 yards and above the

vegetation would probably be more effective, or 40 lb. at 20 yards, which would be more economical.

3. The time-fuse used, the only available length, was too short. It meant that the lighter had to enter the roosting area and the birds were disturbed round the first charge. The fuses should come right out of the area being blasted so that no disturbance is caused.

4. The number of people trampling around laying charges should be kept to a minimum so that as little disturbance as possible is caused.

CONCLUSION

This method promises successful use under Tanganyika conditions when the birds nest and roost in great colonies in swamps. The method will be expensive but almost complete control of the swarm should be obtained. The cost of doing the 1,200 square yards worked out as follows:—

	Sh.
Cordtex	115
Gelignite	457
Labour	25
	<hr/>
	Sh. 597

To have charged the whole area would have cost some Sh. 3,000 to Sh. 4,000 but for that money some 200,000 birds and potential birds would have largely disappeared. As these *Quelea* are far and away the most dangerous pests to African and other grain crops, such an expenditure would seem well worth while. It is believed that no other known method of control will reduce the breeding birds as completely.

The chief difficulty in using this method is discovering the nesting area which is always in deep swamp, or in large areas of tall grass such as *Panicum maximum*. By watching the flight of the birds in the evening, however, a rough idea of the position can be obtained.

ACKNOWLEDGMENTS

To Mr. Wilson of the Sudan Agricultural Service for showing what can be done by blasting *Quelea* in their roosts; to Messrs. Mrisho Kiwamba and Ali Mwachande for finding the colony; to Mr. G. Goodhew, Agricultural Assistant, for thinking of Cordtex; to Messrs. Drew and Foreman, Agricultural Assistants, and Mr. Boyi Mtoto for so nobly assisting the author in laying the charges and withstanding the attentions of a myriad mosquitoes while waiting for the charge to explode; and to Mr. H. Smart, Acting Deputy Director of Agriculture for spade-work in Dar es Salaam to produce the materials.

SOIL AND WATER CONSERVATION IN SISAL

Explanation of the co-ordination of methods of contour planting and rail haulage

By T. R. Brook, Assistant Soil Conservation Officer, Kenya

(Received for publication on 22nd September, 1952)

It has been noted that in recent years a considerable amount of erosion has occurred in sisal lands in Kenya, especially where the sisal rows run directly up and down hill on slopes over 2 per cent approximately. This may be due to the fact that many sisal planters are now clean-weeding their sisal for two years or so after planting. In the past the sisal was only weeded sufficiently to ensure that the sisal plant was established and then grasses and weeds were permitted to grow undisturbed and in time "neglected forestry" conditions prevailed. This cover certainly prevented erosion, but now during the period that sisal is clean-weeded and the land is without cover, erosion may occur, especially when the cultivation has been done by an implement which tends to throw soil up against the plants and form a "channel" between rows. Run-off rapidly scours this channel when not on or near the contour, and it is frequently seen that over one foot of soil has been lost even on short slopes. Such losses must inevitably mean in time a decrease in plant quality and rate of growth, and increasing susceptibility to drought and disease.

Until recently, the owners of many large sisal estates have considered that it was not possible to use contour planting methods without interfering with the efficiency of their leaf-cutting and haulage systems. Since the leaf cutters carry along the rows to the feeder lines, the aim has been to ensure that the feeder lines should cut the rows of sisal at as near a right angle as possible. But since the grade of the feeder lines is limited to the haulage power used (see below) and because the lands planted have slopes up to 20 per cent it will be seen that sisal rows planted at right angles to the feeder lines have a considerable slope of up to 18 per cent. It was thought that if sisal rows were on the contour the angle of junction between the feeder lines and the sisal rows would be very acute and that to cut leaf it would be necessary to clear lanes at right angles through the sisal rows for carry to the feeder lines. This is not so, and the only requirement is the probable laying of more feeder lines. (See the lower left-hand corner of the map.)

The first essential of any field plan combining contour planting and a planned haulage system is a survey. The map should show contours at 10-ft. vertical interval or less if possible. Given a map of an area it is not difficult to plot therein the permanent main line to any required grade and also the portable feeder lines. The marking of the position of the feeder lines in the field should be done before the plants are too high by means of an Abney level (or similar instrument) and chain. These can be permanently marked with posts at tangent points. Note that the main natural drainage lines in an area should be left under grass cover. This is shown on the diagrams.

When marking the position of the main lines and portable feeder lines on the map and on the ground, the following points should be considered:—

- (a) The grade on which the lines are laid will, of course, depend on the type of traction power used; the following are believed to be the normal grades:—

Main line—

Locomotives only— $1\frac{1}{2}$ per cent.

Feeder lines—

Locomotives—full load—uphill haul—2 per cent average.

Locomotives—empty—uphill haul—4 per cent average.

Oxen—full load—uphill haul—2 per cent.

Oxen—empty—uphill haul—8 per cent.

- (b) The length of carry of the leaf cutters. This is normally 75 yards in any one direction which means 150 yards maximum total carry between feeder lines. When planning and marking the intervals between feeder lines it must be remembered that the length of carry is measured along the contour, which may mean that the distance between feeder lines is less than 150 yards, though the carry is of the correct length.

- (c) It is necessary to plan the position of the feeder lines to ensure that they are of the maximum length—this is to enable the leaf cutters to deal with as large an area as possible at one time, and so far as possible to obviate the laying for short periods of short lengths of track—though track spurs may be necessary to reach awkward areas.

Contour Planting

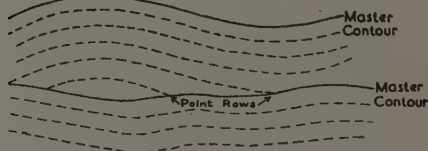
At the present time the methods used are based on a series of "Master Contours"—the rows of sisal being planted parallel thereto.

When a parallel is made to a true contour it is obvious that the parallel will be "off" the contour and that it will have a grade somewhere along its length. The greater the distance of the parallel from the contour the higher the grade along its length. So it is with sisal planting, and it has been found necessary to insert another master contour when the rows have a grade of $1\frac{1}{2}$ per cent.

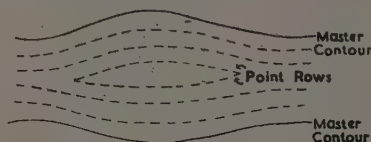
A method used by the Soil Conservation Service of the Kenya Agricultural Department to determine the distance between "Master Contours" is: Assuming that the top contour of a field has been pegged out—take two points A and B—800 feet or so apart on that contour, preferably over that stretch of contour where the land slope obviously changes from a shallow slope to a steep slope. From A and B lay off lines 100 feet long downhill to points A1 and B1 respectively, at right angles to the contour. Ascertain the difference of level between A1 and B1 and their distance apart and thereby the grade. Having found the grade it is a matter of simple proportion to calculate the distance from the contour above where the rows will have a grade of $1\frac{1}{2}$ per cent, and to mark out another contour at that place. The procedure is then repeated. This method, though not absolutely accurate, has been found to work very well in practice over large areas.

Methods used

- (1) Rows are planted parallel to a "master contour"—any point row emerges at the next "master contour" below.



- (2) Rows are planted parallel to both lower and upper contours—any point row occurs in centre of strip between contours.



- (3) Every alternate master contour becomes a grass strip approximately 18 ft. wide. Sisal is planted so that any point row comes out on to the grass strip. For ease of cultivation of point rows this is probably the best method because tractors can turn without difficulty into the point rows, and if necessary the grass strips can be used as roads of access. This method has been used on the maps shown here.

Planting and Marking of Rows

Assuming that the master contours have been pegged out and the ground is ready for planting a simple method of marking rows and planting at the same time is as follows.

A marker bar is attached to the rear of the tractor and so pivoted that it can be swung to mark to the right or left of the tractor. On the outer end of the bar is attached a plough disc and the length of the marker is of course equivalent to the distance required between rows. The tractor should also have an attachment on the rear, such as a toolbar plus chisel or heavy tine.

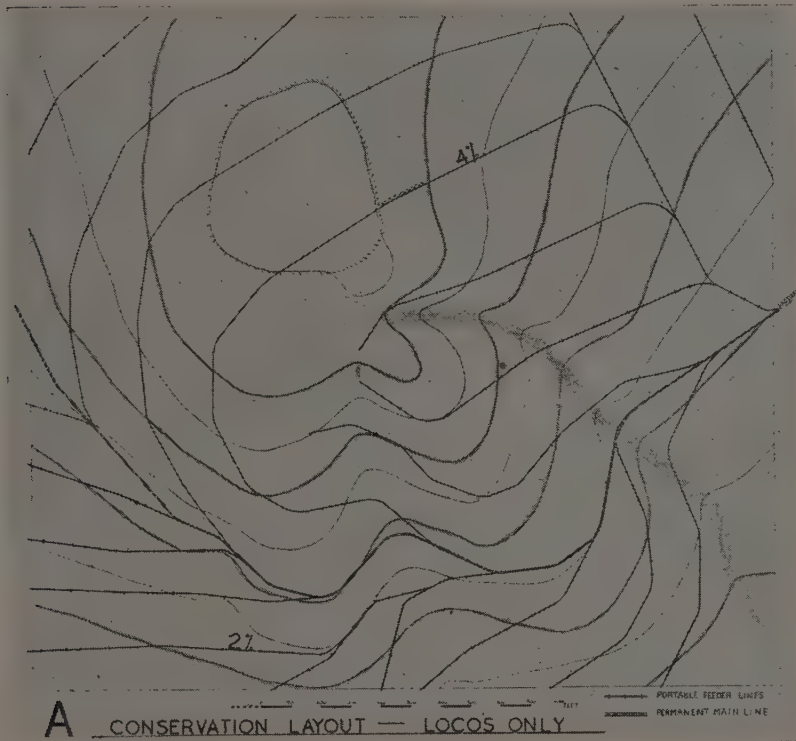
The procedure is that the tractor follows the master contour. The chisel or tine makes a groove of sufficient width and depth to take the planting material and at the same time the marker bar is delineating the next row to follow by the tractor. For double row planting use two chisels or tines.

Explanation of the Maps

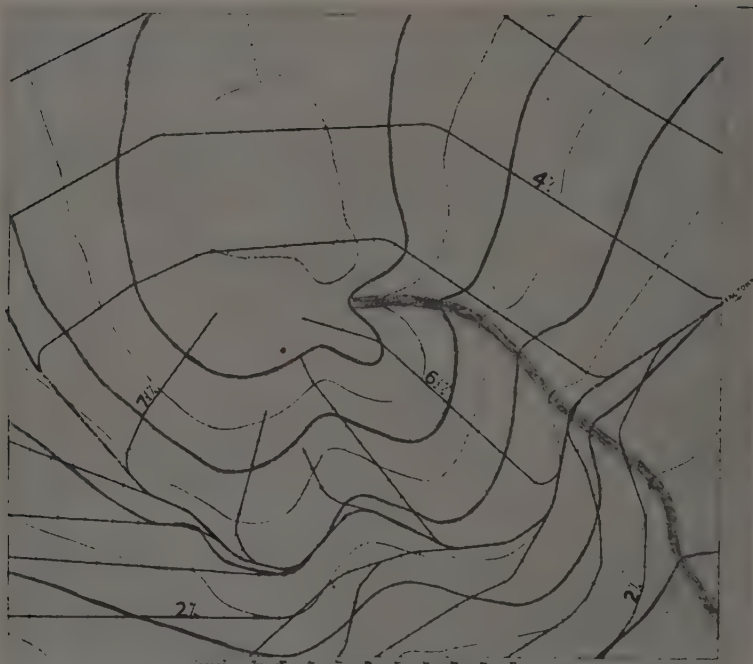
The maps show an area of approximately 130 acres with slopes varying between 0 per cent and 10 per cent. This piece of land was chosen to demonstrate how contour planting and rail systems could be combined even on land having a very irregular topography and showing a main drainage line left under grass.

Map A—Locomotives Only

Certain estates cannot use animal haulage on the feeder lines due to the presence of tsetse



KEY	
	PERMANENT MAIN LINE
	PORTABLE FEEDER LINE
	MASTER CONTOUR
	GRASS STRIP ON CONTOUR
	NATURAL DRAINAGE WAY
	LEFT UNDER GRASS
	HEADLAND
	ACCESS LANE
	SISAL ROWS



CONSERVATION LAYOUT — OX HAULAGE ON FEEDER LINES.

B

KEY

- PERMANENT MAIN LINE
- - - PORTABLE FEEDER LINE
- MASTER CONTOUR
- GRASS STRIP ON CONTOUR
- NATURAL DRAINAGE WAY
- LEFT UNDER GRASS
- ||||| HEADLAND
- - - ACCESS LANE
- SISAL ROWS

fly and consequently all haulage must be done by mechanical means, principally locomotives. This means that haulage grades are limited and that to cut certain steep areas roundabout routes must be found. It will be seen that in the lower left-hand corner of the map the contoured sisal rows meet the feeder lines at an acute angle—the distance apart being as low as 70 yards but the average carry is 150 ft. between lines. The only way of avoiding such situations is to arrange, as far as possible, that the route of the permanent main line passes along the lower edges of the sisal *shambas*, thereby reducing the uphill hauls of leaf to a minimum.

Map B—Ox Haulage on Feeder Lines

It will be noted that since oxen can be used on steeper grades than can locomotives, the feeder line routes cut the sisal rows at an angle nearer to 90 degrees than in Map A; consequently the distance between feeder lines is greater than on Map A. This only applies to uphill hauls empty, because in A the uphill hauls full produce the situation of frequently causing the feeder line routes to be too close together but the carry remains maximum length of 150 yards between lines.

Summary

It will be noted that contour planting and a complete locomotive system requires that more feeder lines be laid than the ox haulage system—in this instance 14 per cent more, but that does not mean that more track is required. The feeder lines are portable and therefore it means 14 per cent more work for the track-laying gangs.

It must not be considered that contour planting is the complete answer to all erosion problems in sisal. Erosion rates vary from *shamba* to *shamba*, depending upon soil type, physical condition, cultivation methods used, infiltration rates, slope, etc., and while contour planting may suffice to control erosion on most areas, it may be that those areas suffering from very severe erosion may also require the application of other anti-erosion methods, such as cut-off drains, etc.

Other methods of haulage exist, such as tractor plus a team of trailers, and lorry transport. The former especially appears to hold much promise and greatly simplifies the application of anti-erosion measures and contour planting, for the unit is not held to any fixed grade. It remains to be seen whether the cost per ton mile of such a method will compete favourably with rail haulage.

A NOTE ON THE "WHISTLING THORN" IN THE NAIROBI AREA

By W. R. Birch, Pasture Research Officer

(Received for publication on 14th October, 1952)

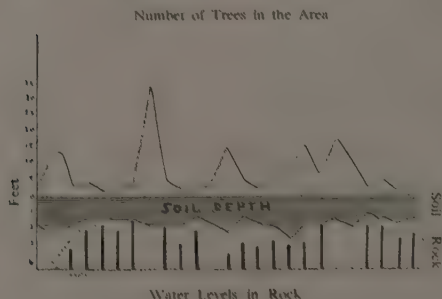
It is frequently assumed that the mosaic pattern of the distribution of trees and forest in East Africa is determined primarily by the water-table level, though no data have been published.

The opportunity was taken, therefore, during the short rains of 1951 to record the water levels, soil depths, and vegetation along a line of pits on the Nairobi plains near Eastleigh where Whistling Thorn (*Acacia drepanolobium*) and Red Oat grass are dominant features of the vegetation. The soil is of the "black cotton" type characteristic of the plains.

The pits were about 4 ft. deep and penetrated about 2 ft. into the grey alkaline rock which underlies the soil. Twenty-four pits were recorded along a 2,160-yard transect, the distance between pits being 90 yards. Soil depths and water levels were measured by tape. Three counts of Whistling Thorn were made at each pit:—

- (1) Total number within a 30-ft. radius of each pit.
- (2) Numbers of trees (excluding seedlings up to 6 in. high) within a 25-ft. radius.
- (3) Numbers of seedlings within a 25-ft. radius.

The results of (2) are shown in the graph. This graph shows the number of trees at each pit, the soil depth, and the level of the standing water in each pit. These indicate that the higher the water level the fewer are the trees. There is also an indication that soil depth may be important.



Similar results, though not so clear (except where there was no water in the pits), were obtained with the 30-ft. counts. This might be expected, since seedlings with comparatively short roots would not be so responsive to sub-soil water. Also the 30-ft. radius might be too wide, in that conditions at its periphery might not be the same as those at the centre.

When the pits were visited a second time, most of them were dry. The ones with the fewest trees were the ones containing water.

The soil pH, for which I am indebted to Messrs. E. Bellis and H. Dougall, was determined at two pits:—

Trees			No Trees		
Horizon		pH	Horizon		pH
Inches			Inches		
0-2	..	5.2	0-4	..	5.3
2-14	..	5.9	4-16	..	5.6
14-24	..	7.2	16-24	..	6.5
			24-28	..	7.7

The reasons for the differences in the water level at the various pits might be due to differences in evaporation, differences in the water transpired by the vegetation, or to greater percolation through the rock at some pits. The latter is the most reasonable assumption, and if this is so then it is the degree of weathering of the sub-soil rock and hence the rate of percolation through it that determines the water level. The waterlogging which occurs when percolation is slow seems inimical to the growth of Whistling Thorn.

A list of the grasses and herbs was made at each pit, but no clear-cut differences emerged, although there was a suggestion that Red Oat grass was more abundant where there were no trees. *Eragrostis heteromera*, another of the dominant grasses, appeared to do the opposite. The large number of species present (37) made the quick eye estimation of their relative dominance and abundance unreliable.

There was unfortunately no time to study rooting systems with the soil horizons, and these sketchy data are only presented here because further observations are not likely to be made for some time to come.

NOTES ON TROPICAL AFRICAN DODDERS

By B. Verdcourt, Assistant Taxonomic Botanist, F.A.A.F.R.O.

(Received for publication on 22nd October, 1952)

My attention has been drawn to an article by Dr. Nattrass in this journal (1941, *E.A. Agric. J.*, 6, 187-8), on the subject of *Cuscuta* species in East Africa. The fact that the article contains many wrong names is in no way any fault of its author. The account of the genus in the Flora of Tropical Africa (1906, 4 (2), 202-6) is exceedingly poor and inaccurate, the keys given to the species being quite useless. Moreover, whilst working at Kew during the preparation of an account of the genus for the Biological Flora of the British Isles and for the Flora of Tropical East Africa, I found that nearly half of the specimens of *Cuscuta* preserved at Kew were wrongly determined. Since the account of the genus for the new flora must await the completion of the *Convolvulaceae* by some other worker, a task that may not be started for several years, these notes are being published to correct previous literature.

Cuscuta chinensis Lam. does not occur in Kenya nor in West Africa, despite the fact that it is recorded by Hutchinson & Dalziel (Flora of West Tropical Africa, 1931, 2 (1) 219) and by many others. The only authentic specimens I have seen are from the Sudan and Eritrea. Most of the specimens previously called *C. chinensis* are referable to *C. australis* R. Br. (= *C. cordofana* (Engel.) Yunck.) and some to practically any of the other species recorded from Africa.

Cuscuta campestris Yuncker is the most common dodder in Africa and occurs throughout the continent on both wild and cultivated plants. It is a native of the United States.

C. epilinum Wiehe is a much rarer introduced dodder and is confined to flax. I have seen genuine specimens from Uganda.

Cuscuta australis R. Br. is a species widely spread in the old world. In East Africa it is often found on marsh plants *Hydrocotyle*, *Polygonum*, etc. It is not at all common.

C. kilimanjari Oliv. is possibly the best known of the Kenya species. It is a forest species chiefly, and is practically confined to hosts belonging to the family *Acanthaceae*. It is a large-flowered species and very conspicuous.

C. cassytoides Nees ex Engelm. (= *C. ilmorensis* Nees ex Engelm.) is a rather rare forest species but occurs in several parts of Tanganyika and I have recently recorded it for Kenya in the Karura Forest.

C. planiflora Tenore, is a very widely distributed species occurring in many parts of Africa and the Mediterranean. There are numerous races and sub-species, some occurring on cultivated plants. *C. abyssinica* A. Rich. is merely a variety and grows in the Teita-Usambara area as well as in Abyssinia.

C. hyalina Roth. (= *C. epitribulum* Schimper) is a fragile species occurring on *Trianthema* in dry places. Widely distributed but seemingly rare. Occurs in Tanganyika, Uganda and Kenya.

C. obtusiflora H.B. & K. is often recorded from Africa (Flora Trop. Africa, loc. cit 205, etc.) but is confined to South America. It is admittedly very close to *C. australis*. About 70 per cent of African material named *C. obtusiflora* has, however, proved to be *C. kilimanjari*. This mistake can be traced back to Oliver's original description of the latter. He states that the epistamineal scales are absent; but in fact they are present and large. Using the floras available this species always keys to *C. obtusiflora*.

Dr. Nattrass mentions the European *C. trifolli* Bab. This is now considered morphologically identical with *C. epilithum* (L.) Murr.

The following key may help Agricultural Officers and others to distinguish between the species. More host information is very much required but it is essential that the dodder should be precisely named. Specimens of dodder in flower and fruit attached to their host should be sent to the Botanist in Charge, East African Herbarium, P.O. Box 5166, Nairobi. Material from any part of Africa would be welcomed. Accurate host data could then be compiled.

KEY TO EAST AFRICAN DODDERS

This has been made as simple as possible and the characters mentioned can be seen with a hand lens, although a binocular microscope is desirable.

1	Style one	<i>C. cassytoides</i>	6	Stigmas relatively stout. Confined to flax or plants growing with flax	<i>C. epilinum</i>
	Styles two	2		Stigmas slender. On a wide variety of hosts. (<i>C. abyssinica</i> has styles and stigma 1.5—2 mm. long. Typical <i>C. planiflora</i> has them 0.5—1 mm. long)	
2	Stigmas globose	3	3		
	Stigmas linear	6			
3	Corolla lobes ("petals") pointed	4	4		
	Corolla lobes blunt or rounded	5			
4	Scales present below the stamens at base of corolla tube	<i>C. campestris</i>	5		
	Scales absent	<i>C. hyalina</i>			
5	Flowers large. Grows on forest floor herbs and by forest tracks, on Acanthaceae. Fruit splitting round the base	<i>C. kilimanjari</i>	6		
	Flowers smaller. Often on marsh plants. Fruit not splitting round the base	<i>C. australis</i>			

These notes are not altogether in accord with the standard monograph on the genus by Yuncker ("The Genus *Cuscuta*", 1932, *Memoirs Torrey Botanical Club* 18), but too many species are recognized in this work and his naming has been modified.

FLORA OF TROPICAL EAST AFRICA—ARROW-ROOT

In the prosperous days of Queen Victoria and Edward VII the hot-houses and conservatories of the well-to-do were gorgeous with the very decorative and often bizarre leaves of foliage plants besides orchids, ferns and other tropical flowering plants. Such decorative foliage plants and the more typical plants of hot-houses are now, except for the rare few, things of the past and to-day are only met with in tropical rain forests or in the more fortunate of the botanical gardens which have the facilities and the labour to grow and display them.

Many of these decorative foliage plants belong to the arrow-root family Marantaceæ, the East African members of which have just been described and published in this family of the Flora of Tropical East Africa.

The Marantaceæ is closely related to the banana, ginger and canna families, it is a family of perennial herbs confined mostly to swamps in rain forest, and except for their foliage they are of little interest to horticulturists as their flowers are not very showy, but, due to their complicated structure, are of great interest to botanists.

Five genera are described in the Flora of Tropical East Africa. They are *Trachypodium* with one species, *T. braunianum* (K. Schum.) Baker found in Uganda only, but extending into the Anglo-Egyptian Sudan, Belgian Congo and Sierra Leone; *Megaphrynium* one species, *M. macrostachyum* (Benth.) Milne-Redhead in Uganda and with a similar distribution; *Sarcophrynium*, one species, *M. schweinfurthianum* (O. Ktze) Milne-Redhead again in Uganda but only extending to the Belgian Congo and the Anglo-Egyptian Sudan; *Marantochloa* with three species, all three forming a West African flora element with a distribution by way of Uganda into the Lake Province of Tanganyika with the exception of one species *M. leucantha* (K. Schum.) Milne-Redhead which has a discontinuous distribution from Uganda by that of the Lake into the Tanga and Eastern Provinces of Tanganyika; the fifth *Atenida* with one species, *A. conferta* (Benth.) Milne-Redhead, again only found in Uganda with a distribution westwards as far as the Gold Coast in West Africa.

Strangely enough the family is not represented in Kenya or Zanzibar but there is no reason why some of them should not turn

up in the Kakamega District of Kenya as the forest there has quite a number of members of the West Africa flora. In fact the Marantaceæ as described in the Flora of Tropical East Africa can be considered as representatives of the West Africa flora with a very limited distribution into the western portions of East Africa.

In preparing the Marantaceæ for the press, Mr. Milne-Redhead of Kew had a great deal of difficult taxonomic research to do on this very complicated family. Of the seven species described, six had to be transferred from other genera to which they did not rightly belong, in fact some species had been placed in as many as three different genera by earlier botanists.

This part of the Flora of Tropical East Africa contains nine pages only. There is a full description of the family, a key to the genera, each one of which is fully described, and as the genus *Marantochloa* is the only one with three species, a key to these species is the only key necessary for specific distinctions. Unfortunately there are only two figures, one of the fruits and seeds of members of all the genera by the artist M.R., the other a full-page illustration of *Marantochloa purpurea* (Ridl.) Milne-Redhead by another artist, D.R.T. Why, oh why, with so critical a family, could not the whole five genera have been fully illustrated and thus inducing a layman such as foresters and possibly plant ecologists and others to take more than a passing interest in this very difficult family.

As I have said before, the booklet consists of nine pages with two line drawings and an index. It was published by the Crown Agents in August, 1952, and sells in London for the sum of Sh. 1/3 and is obtainable, like the other two families, from the Government Printers in East Africa and Zanzibar, also the Uganda Bookshop, Kampala, Uganda. It is hoped the author, Mr. E. Milne-Redhead, who is to be congratulated on the completion of this critical revision of a difficult family, will not be long in revising and publishing another family for the Flora of Tropical East Africa, each part of which is eagerly awaited by all those interested including those who have to make a study of East Africa's indigenous plants.

P.J.G.

FLORA OF TROPICAL EAST AFRICA—OLIVES

Foresters and gardeners should be interested in the latest part of the Flora of Tropical East Africa. The family Oleaceae has now been published and consists of 31 pages with seven figures, bound in a paper cover and issued in London on 1st July, 1952, for the sum of Sh. 2/9.

It opens with a description of the family as a whole and is then followed by a key to the genera.

Five genera are described, *Schrebera* with seven clearly defined species and three uncertain; *Olea*, with six species; *Linociera* with *L. johnsonii* Baker and *L. nilotica* Oliv. *Dekindtia africana* Gilg and *Jasminum* with 20 species.

Of the seven species of *Schrebera*, to which there is a key, *S. alata* (Hochst.) Welw. is the most widely distributed, being found in Uganda, Kenya and Tanganyika and extending from Ethiopia into Nyasaland and Angola. This is illustrated by a full-page line drawing by D.R.T. consisting of a branchlet with inflorescence, a flower bud, calyx, corolla, an ovary style and stigma, a fruit natural size as well as a seed.

The genus *Olea* to which the olive belongs is of great economic importance, not only on account of its oil-bearing seeds but for its woods, as three of its six species yield timber: they are the Brown Olive, *Olea chrysophylla* Lam., the East African Olive or Musharagi, *O. hochstetteri* Baker and the Elgon Olive or Loliondo, *O. welwitschii* (Knobl.) Gilg and Schellenb.

O. chrysophylla besides being found in East Africa, occurs in Zanzibar, has a wide distribution from Central, East and North-east Tropical Africa, South Africa, the Mascarenes, east to northern India and western China. The East African Olive, *O. hochstetteri*, is found in the three East African Territories and extends into Ethiopia, the Anglo-Egyptian Sudan, the Cameroons, Ivory Coast and the Congo. Elgon Olive or Loliondo, *O. welwitschii* was first recorded from Angola and has a distribution from that country to Uganda, Kenya, Tanganyika and Northern Rhodesia. To botanically inclined foresters Elgon Olive has hitherto been known under the botanical name *Steganthus welwitschii* as it was said to differ from *Olea* on account of the imbricate folding

of its corolla segments. The author, Dr. W. B. Turrill, says, however, the folding of the corolla segments varies so much in a single flower that it cannot be maintained in *Steganthus*, in fact the species is in many characters very similar to the East African Olive.

Of the two species of *Linociera*, *L. johnsonii* is a West African species with a distribution into Uganda and north-west Tanganyika and has yet to be found in Kenya. *L. nilotica* was originally discovered in Madi, West Nile District, Uganda, by the Speke and Grant Expedition, besides occurring in Kenya and Tanganyika, it has a distribution to West Africa by way of the Anglo-Egyptian Sudan, Cameroons, Chari, Ivory Coast, Togo, Dahomey and Nigeria.

Dekindtia africana was first described from Angola but has now been found in the Transvaal, Southern Rhodesia, Nyasaland, Tanganyika and Kenya and is common in and around Nairobi, it is a large shrub or small tree to 40 ft. with white flowers and has infrequently been planted in gardens.

To the layman the genus *Jasminum* will be rather terrifying with its 20 species, a key to all of them is provided, the main distinctions being a group of five species with compound leaves and another group containing the remaining 15 species having simple leaves.

The best-known Jasmine and the most widely travelled is *Jasminum fluminense* Velloso, better known to some of us in East Africa as *Jasminum mauritanicum* described by De Candolle in his Prodomus in 1844 on a specimen collected by Bojer in Mauritius. This most frequently used specific name has now to be abandoned in favour of the little-known but earlier name *J. fluminense* published in 1825 on a plant cultivated in Brazil at Santa Cruz near Rio de Janeiro! It seems to be the most widely distributed of the Jasmynes being found throughout Tropical Africa as far as South Africa, in Mauritius, the Seychelles and in Arabia, it is found also in the West Indies and South America where it has been introduced. Not only is it widely distributed but it is also the most variable, under the specific name *J. fluminense*; there is a key to five intra-specific varieties, one of them sub-species *nairobiense* being endemic in the Nairobi District of Kenya.

Many of the species are very ornamental and should be more grown in gardens; none appears to be exploited for its essential oils, no doubt because oil of Jasmine can be produced much cheaper synthetically than by the enfleurage process used for obtaining the essential oil of Jasmine from the flowers of the so-called Spanish or Catalonian jasmine *J. grandiflorum* L.

The five genera are illustrated by line drawings, the genera *Olea* and *Jasminum* are represented by two each. Some of them are not as good as in the first family Ranunculaceæ that was published earlier in the year.

A little more care could have been taken in correcting the manuscript and the proofs, as a collector's name to one specimen cited has been omitted and some place-names have been ill spelt. The author, however, Dr. W. B. Turrill, Keeper of the Herbarium, Royal Botanic Gardens, Kew, is to be congratulated on the completion of a very critical family for the Flora of Tropical East Africa. The book is obtainable from the Crown Agents, London, all Government Printers in East Africa and Zanzibar as well as The Uganda Bookshop, Kampala, Uganda.

P.J.G.

FURTHER NOTES ON THE SUSCEPTIBILITY OF WOOD TO TERMITE ATTACK

By P. B. Kemp, Termite Research Unit, E.A.A.F.R.O.

(Received for publication on 23rd September, 1952)

In a previous number of this journal (Kemp, 1951) a method was described for comparing the susceptibility of different types of wood to termite attack. While at Amani, the opportunity was taken to expose a further sample of local trees. Small pegs, 30 cm. in length, were driven into the ground in valley woodland on red soil, and examined after eight months. The results were assessed as before by allotting a score to each log according to the degree of attack by termites. Unattacked = 0, slight attack = 1, much attacked = 2, almost consumed = 3. From these results the following list was compiled:—

Readily attacked (score over 40)—

- Cussonia zimmermannii* Harnis (Araliaceæ).
- Trema guineensis* Ficalho (Ulmaceæ).
- Antiaris usambarensis* Engl. (Moraceæ).
- Macaranga usambarica* Pax & K. Hoffm. (Euphorbiaceæ).
- Piptadenia buchanani* Baker (Mimosaceæ).

Moderately attacked (score 5–40)—

- Grewia* sp. (Tiliaceæ).
- Allanblackia stuhlmannii* Engl. (Guttiferæ).
- Bridelia micrantha* (Hochst.) Baill. (Euphorbiaceæ).
- Sterculia appendiculata* K. Schum. (Sterculiaceæ).
- Albizia gummifera* (Gmel) C.A. Sm. (Mimosaceæ).
- Chlorophora excelsa* (Welw.) Benth. & Hook. (Moraceæ).
- Harungana madagascariensis* Lam. (Hypericaceæ).

Rytigynia amaniensis (K. Krause) Bullock (Rubiaceæ).

Markhamia zanzibarica K. Schum. ex Engl. (Bignoniaceæ).

Almost unattacked (score under 5)—

Aristolochia densivenia Engl. (Aristolochiaceæ).

The principal termites consuming the pegs in this area were *Microtermes vadschaggæ* (Sjostedt) and *Microcerotermes parvus* (Haviland).

An additional sample of pegs was exposed in thicket on the coastal plain near Tanga. In this area, although humus-feeding termites are very common, it was found that wood-eating species were not abundant in the particular area selected. Soft woods such as *Commiphora schimperi* Engl. (Burseraceæ) were only partially eaten after eight months, but *Dichrostachys glomerata* Chiov. (Mimosaceæ), *Premna chrysoclada* (Bojer) Gürke (Verbenaceæ), *Harrisonia abyssinica* Oliv. (Simarubaceæ) and *Manilkara densiflora* Dale (Sapotaceæ) were almost unattacked at the end of this period. The termites attacking the pegs in this locality were most frequently *Microtermes usambaricus* Sjostedt and *Microtermes vadschaggæ* (Sjostedt).

ACKNOWLEDGMENT

I am grateful to Mr. B. Verdcourt for assistance in identifying the trees.

REFERENCE

- Kemp, P. B. (1951).—The Susceptibility of Wood to Termite Attack. *E.A. Agric. Journ.* Vol. XVI, 3, p. 122.

THE INTERNATIONAL FEDERATION OF AGRICULTURAL PRODUCERS

Initiated by the National Farmers' Union of England and Wales, this world-wide organization of farmers was established in 1946, with Sir James Turner as first President.

To-day 38 farmers' organizations from 28 nations are represented. The Kenya National Farmers' Union is a member. At the 1951 conference of the I.F.A.P., held in Mexico, observers from 15 additional non-member nations and 12 international organizations were present.

The first object of the I.F.A.P. is "to promote the wellbeing of all who obtain their livelihood from the land, and to assure to them the maintenance of adequate and stable remuneration".

Between conferences, the I.F.A.P. Regional Committees on Agricultural Co-operation and its Co-operation Officer operate in close liaison with the divisions of the F.A.O. and the International Labour Office, which promote

extension of agricultural co-operation and rural welfare.

The I.F.A.P. will hold its Sixth Conference in Rome in the spring of 1953 at the new headquarters of the Food and Agriculture Organization of the United Nations.

The Federation reports good progress in the preparation of commodity reports; these analytical studies of a wide range of agricultural products and requisites will contain draft recommendations dealing with the production, trade and price stabilization policies necessary to maintain and expand food production.

Through I.F.A.P. we learn that the F.A.O. has opened the largest agricultural library in Europe, at its headquarters in Rome. The 350,000 volumes come from the former International Institute of Agriculture, the International Silvicultural Centre and the F.A.O. Library. The new library is named in honour of David Lubin, American founder of the International Institute of Agriculture.

REVIEW

"YEAR BOOK OF AGRICULTURAL CO-OPERATION, 1952". Edited by Horace Plunkett Foundation (Basil Blackwell, Oxford, Sh. 21).

This book is a collection of 44 articles and a selected and annotated bibliography of co-operation. The articles vary from the lengthy ones on France and French North Africa, by Margaret Digby of the Horace Plunkett Foundation, to anonymous contributions of a page or so. The countries covered range from Israel to Japan, although, of course, there is nothing from or about Russia; there are, however, some interesting accounts of the satellite countries. The British Commonwealth is well represented, over one-quarter of the book being occupied by articles on the Colonial Empire.

The Co-operative Adviser to the Colonial Office, Mr. Surridge, has written a short account of developments that have been fostered by the Colonial Office aimed at raising the standard of farming and of living through the improved business methods that co-operation can provide. These methods take mainly the form of credit, thrift, producer and consumer societies, and co-operative banks. The greatest opportunity for development is naturally in those Colonies where an important

cash crop is produced for the world market, e.g., cocoa in the Gold Coast and Nigeria and coffee, where the development in Tanganyika of the Kilimanjaro Native Co-operative Union shows what can be achieved when patient, but firm, guidance and instruction are systematically provided over the long initial stages.

East African readers will turn with special interest to the separate short articles on Tanganyika and Uganda—there is nothing about Kenya.

The Uganda article is condensed from the Report of the Registrar of Co-operative Societies, and the Tanganyika one from the Report of the Registrar. As the Year Book under review is dated 1952, the latest reports available would be those for 1950, which would appear some time in 1951. Internal evidence shows that the Uganda article is condensed from the 1950 Report; but the Tanganyika one is specifically from the 1949 Report, and one wonders whether there is any real reason why the release of such an interesting and valuable official report should be so long delayed. Summaries of what are themselves summaries are not possible in the short review but reference should be made to the notable

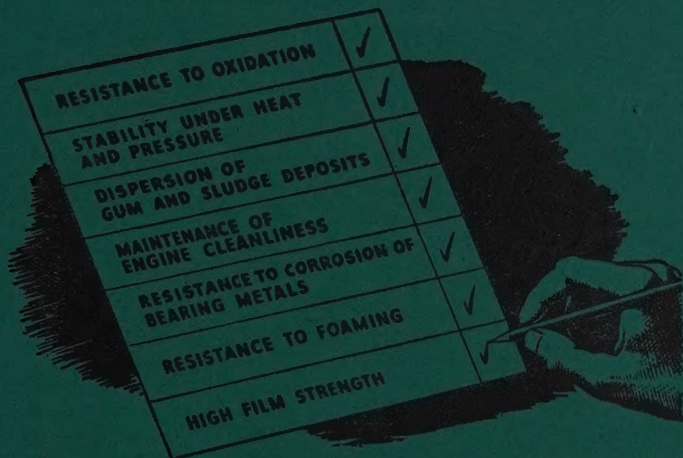
development in Tanganyika of the opening of a vocational school for pupils nominated by the primary coffee co-operative societies, the cost of the venture being met by the Moshi Native Coffee Board.

A comparison of the 44 articles brings out strikingly the widely different social structures and land-use customs within which co-operative advances have to be made, and explains the wide variations in the kinds of co-operative devices employed. But there is a hidden unity in this diversity, that is not mentioned in any of the articles and it is appropriate to conclude this review with a brief reference to that unity. The major obstacle to all agricultural advancement is found wherever the land-use customs or the level of social emergence (or both) have prevented the development of a corporate or individual responsibility for the wellbeing of the soil. The extreme examples are fragmentation of holdings by inheritance, as in India or Cyprus, and the vague but complicated collective responsibility, shared by ancestral spirits and the living, so common among Africans, where ownership in our sense does not exist. Some means must be found of getting round such obstacles; removal is impossible in any reasonable time. Co-operative societies are one way round. In the case of fragmentation, the owners must give a co-operative society (that may well be composed of the owners themselves) a long

lease of the whole area, which is then properly regrouped into economical farm units that are sublet to suitable tenants (who, again, may well be some of the landowners themselves). When a landowner dies, the laws of inheritance operate in the traditional manner; but harmlessly because, in practice, only the rent is fragmented; the land itself is not physically divided, although the map may well be; the boundaries of the sublet units, which bear no relation to the landowner's boundaries, are quite unaffected. This method was followed with great success in the development of the Sudan Plantations Syndicate in the Sudan Gezira. At the other extreme, in which practically only the usufruct of the land is understood by the African, a co-operative society offers some hope of introducing the idea of a corporate responsibility for the care of the soil, that may in time develop into group ownership of land. It is quite certain that until the conception of ownership develops—whether it is state or group ownership or individual freehold, is immaterial to the argument—there will not be any permanent improvement in the fertility of the soil. The supreme virtue of a co-operative society in this connexion is that it is, in effect, a public utility corporation, whose constituent members can die, and be replaced, without any check in the steady forward policy of the society.

B.A.K.

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